UNIVERSITY OF SANTIAGO DE COMPOSTELA

FACULTY OF ECONOMIC AND BUSINESS SCIENCES

DOCTOR OF PHILOSOPHY

IN

TOURISM MANAGEMENT AND PLANING

The Synergy between Scuba Diving and Household Behaviour: Testing Plastic and Food Waste

"*The use of natural habitats for tourism education*"

Doctoral thesis submitted by MA Luís Mota

International Mention

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2013

Ph.D. Xosé Manuel Santos Solla, Senior Lecturer of Human Geography, and Director of the Centre for Studies in Tourism [CETUR], at the Department of Geography, of the Faculty of Geography and History, from the University of Santiago de Compostela, Spain.

Hereby CERTIFIES:

That the research work entitled ”The Synergy between Scuba Diving and Household Behaviour: Testing Plastic and Food Waste - The use of natural habitats for tourism education, was proposed, and developed by the Environmental Engineer, from the University of Aveiro in Portugal, and Master in Sustainable Tourism Destination Management, from the University of Las Palmas de Gran Canaria in Spain, Luís Mota, under my direct supervision in the Department of Geography, of the University of Santiago de Compostela, and qualifies him eligible for the Ph.D. degree in Tourism Management and Planning.

Santiago de Compostela, November 25, 2013.

Ph.D. Professor Xosé Manuel Santos Solla	MA Luís Mota

“Through human history, environmental impact has largely been a by-product of human desires for physical comfort, mobility, relief from labour, enjoyment, power, status, personal security, maintenance of tradition and family, and so forth, and of the organizations and technologies humanity has created to meet these desires.”

(Stern, 2000, p.408)

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Abstract

The activity of scuba diving is used for studying behaviours of U.S. visitors to a popular tourist destination in Mexico. The impact created by human activity can produce marine debris and therefore affect the marine environment. The subpopulation of 181 divers was tested for their current household practices regarding discarding plastic and food waste, providing quantitative statistics for divers' referential behaviour. Prior to partaking in scuba diving, certified, trainee, and "one-day-experience" divers attended informal environmental education sessions. Moreover, 30% of all divers involved in the study participated in a web survey analysing the long-term impacts from scuba diving activity. Adapted from the theory of planned behaviour, post-experience observations were used for a Two-Step cluster analysis, which demonstrated that environmental awareness and attitude toward the behaviour can be important predictors for reducing the amount of plastic and food discards in the household. Being a member of an environmental organization does not affect waste management practices, and scuba diving is not a blueprint for behavioural change; however, it definitely plays an important role in creating an awareness of and observing the impacts on the reef. Thus, this nature-based activity is only characterized as a good vehicle for promoting good environmental practices for discarding plastic and food, motivating people to rethink their attitudes toward their behaviour in the household.

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List of abbreviations

AC	Abstract Conceptualization.
AdvD	Adventure Diver.
AE	Active Experimentation.
AIC	Akaike's Information Criterion.
ANOVA	Analysis of Variance.
APC	American Plastics Council.
APIQROO	Administración Portuaria de Quintana Roo, Puertos de Quintana Roo.
ASUR	Aeropuertos del Sureste.
AWARE	Aware.
AWOD	Advance Open Water Diver.
BEH	Behaviour.
BIC	Bayesian Information Criterion.
CE	Concrete Experience.
CF	Cluster Feature.
CMAS	Confédération Mondiale des Activités Subaquatiques.
CONANP	Comision Nacional de Areas Naturales Protegidas
CSD	Commission for Sustainable Development.
DALF	Diplôme Approfondi de Langue Française
DDT	Dicloro-diphenyl-tricloroethane.
DEFRA	Department for Environment, Food and Rural Affairs.
DELF	Diplôme d'Etudes en Langue Française.
DEMA	Diving Equipment & Marketing Association.
DEMO	Acronym for describing socio-demographic variables.
DILF	Diplôme Initial de Langue Française.
DIVE	Dive.
DM	Divemaster.
DSD	Discover Scuba Diving.
EFL	English as Foreign Language.
EPA	Environmental Protection Agency.
EPDM	Ethylene Propylene Diene Monomer.
EPI	Environmental Performance Index.
EPR	Ethylene Propylene Rubber.

ESI	Environmental Sustainability Index.
ERS	Economic Research Service.
FAO	Food and Agriculture Organization.
GBP	Great British Pound.
GDP	Gross Domestic Product.
HATB	Household Attitude Toward the Behaviour.
HDPE	High-density Polyethylene.
HR	House of Representatives.
IBM SPSS	International Business Machines Statistical Package for the Social Sciences.
ICNTB	International Congress of National Tourism Bodies.
ICOTT	International Congress of Official Tourist Traffic Associations.
IMO	International Maritime Organization.
IMSA	Institute of Marine Safety Auditors.
INEGI	Instituto Nacional de Estadística y Geografía.
IPW	International Pellet Watch.
IRT	Item Response Theory.
ITC	Institute for Tourism in Costa Rica.
IUCN	International Union for Conservation of Nature's.
IUOTO	International Union of Official Travel Organizations.
IUOTPO	International Union of Official Tourist Propaganda Organizations.
LDPE	Low-density Polyethylene.
LFPDPPP	Ley Federal de Protección de Datos Personales en Posesión de los Particulares.
LLDPE	Linear Low-density Polyethylene.
LSI	Learning Style Inventory.
MDGs	Millennium Development Goals.
MPA	Marine Protected Areas.
MSD	Master Scuba Diver.
MSW	Municipal Solid Waste.
MXN	Mexican Peso.
NAUI	National Association of Underwater Instructors.
NGOs	Non-Governmental Organizations

NIU	Northern Illinois University.
NOAA	National Oceanic and Atmospheric Administration.
NRDC	Natural Resources Defence Council.
OECD	Organisation for Economic Co-operation and Development.
OWD	Open Water Diver.
OWG	Open Working Group.
PADI	Professional Association of Diving Instructors.
PAH	Polycyclic Aromatic Hydrocarbon.
PBC	Perceived Behaviour Control.
PBT	Persistent Bioaccumulative and Toxic.
PB-1	Polybutene-1.
PCB	Polychlorinated Biphenyl.
PE	Polyethylene.
PET	Polyethylene Terephthalate.
PHA	Polyhidroxyalcanoatos.
Ph.D.	Doctor of Philosophy.
PIB	Polyisobutylene.
PMMA	Polymethyl Methacrylate.
PMP	Polymethylpentene.
PNAC	Parque Nacional Arrecifes de Cozumel.
POP	Persistent Organic Pollutants.
PP	Polypropylene.
PRB	Population Reference Bureau.
PS	Polystyrene.
PTFE	Polytetraflouro-ethylene.
PUR	Polyurethane.
PVC	Polyvinylchloride.
RLI	Red List Index.
RO	Reflective Observation.
SCUBA	Self Contained Underwater Breathing Apparatus.
SD	Scuba Diver.
SDGs	Sustainable Development Goals.
SDI	Scuba Diving International.
SECTUR	Secretaría de Turismo.

SEDETUR	Secretaria de Desarrollo Turístico.
SERNAPESCA	Servicio Nacional de Pesca y Acuicultura
SIDS	Small Island Developing States.
SN	Subjective Norms.
SPSS	Statistical Package for the Social Sciences.
SSI	Scuba Schools International.
ST-EP	Sustainable Tourism – Eliminating Poverty.
TOEFL	Test of English as a Foreign Language.
TPB	Theory of Planed Behaviour.
TRA	Theory of Reasoned Action.
UK	United Kingdom.
UN	United Nations.
UNDP	United Nations Development Program.
UNEP	United Nations Environment Programme.
UNWTO	United Nations World Tourism Organization.
UQRoo	University of Quintana Roo.
US	United States.
USC	University of Santiago Compostela.
USD	United States Dollar.
USDA	United States Department of Agriculture.
WSPA	World Society for the Protection of Animals
WTO	World Tourism Organization.

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Chapter 1

1.1. Introduction

This Ph.D. thesis aims to study behaviours noted for scuba divers in regards to environmental practices in the household. The fact that they spend time submersed in water exploring the beauty of the subaquatic world and observing how fragile the environment is, raises some questions about divers' commitment to reducing their ecological footprint. Do they adopt good environmental practices in general, or is just being environmentally conscious enough?

Another question is what motivates people to go scuba diving, and how much it can affect their decision to partake in nature-based tourism activities. People go scuba diving to benefit from close encounters with marine life, but are there any differences between certified and non-certified divers regarding level of consciousness of their impacts on the environment?

I obtained my scuba diving certification during the summer of 2005 on Cozumel Island in Mexico, just before it was struck by Hurricane Wilma. The area boats a pristine environment where horizontal water visibility can easily reach 25 meters. I started my dives from a swimming pool that led out to the open water via a passage and was able to learn entry-level diving skills while observing marine life. I remember hearing the dolphins making clicking sounds, but at the time I was not sure if it signalled they were happy to be playing with tourists in their confined water facility, or if they wanted to be set free into the open sea where they belong.

This underwater activity enabled me to discover a new world and I slowly came to realize how human impacts can affect underwater creatures and the whole marine environment. The faecal material released by dolphins held in captivity as a tourist attraction causes problems as they are trapped in an enclosed environment by an underwater fence. Despite the existent cleaning procedure, the animals are exposed to a high level of nutrients in the water, which increases their stress levels and also their chances of catching disease – all for the benefit of human amusement. From a different perspective, I

wondered about the loading of propitious nutrients for growing algae, and how much this could affect the surrounding areas by changing the local reef system.

During the diving course I noticed some litter, metal parts, plastic bags and scraps lying on the sea floor, left there a result of previous violent storms and poor waste management procedures on the island. As part of the training, the observation of sensitive coastal areas and how much meteorological phenomena can affect them were covered as a means of imparting environmental education and awareness.

Uzun and Keles (2012) addressed the importance of natural environments where participants can become more thoughtful by collecting first-hand information about them. Natural environments have the ability to provide inputs capable of stimulating a person's learning process (Ozaner, 2004; Uzun & Keles, 2012), used for the purpose of explaining the natural process of life, assisting in developing the cognitive process, and raising awareness. In their study carried out to evaluate the project "Nature Education in Ihlara Valley (Aksaray) and Its Surrounding Area" Uzun and Keles (2012, p. 2913) concluded that a "10-day nature education program" substantially increased the participants' environmental awareness and attitude toward the environment.

When aiming to impart knowledge about a certain attribute or process, educational programs can be designed to reach participants by involving some level of theory and activating their psychological processes. The inclusion of education in nature was used as a strategy to manage tourism-nature synergies, increasing the level of understanding and awareness, leading to more responsible behaviour (Orams, 1994).

My personal life-long learning process demanded that I have more interactions with nature, and driven by a professional need of pursuing a career as a diving instructor. My underwater observations and educational background increased my perception of the anthropogenic impacts on nature, and how much influence humans have on the global ecosystem. Studying responsible behaviours can contribute to education programs, and become a tool for governance and educating new generations.

1.1.1. The scuba diving experience

In ancient times, humans started exploring the wondrous underwater environment by immersing themselves with the aid of rudimentary accessories. Divers became interested in collecting sponges in Greece due to their diverse applicability for hygiene, health therapies and other purposes. The Ancient Greeks used sponges for bathing and the Romans for padding their helmets used on battle. Sponges were utilized as a cleaning tool, for painting and much later for water-filtering systems. In the Mediterranean Sea and the East Indies, the benefits from living on coastal areas sent fishermen out on adventures in the open sea, mainly for fishing to feed populations. Dimmock (as cited in Jennings, 2007) stated that the Australian Aborigines were possibly one of the first races to use a “snorkel” as a breathing tube. According to Cherry (1976), breath-holding for free diving was a way to enable the collection of seafood found on the sea floor and pearls for making jewellery and art crafts.

Authors like Ecott (2001) affirmed that equipment for independent diving started to be developed in the 19th and 20th centuries. It was not until1943 that scuba diving pioneers Jacques Costeau and Emile Gagnan developed equipment and techniques for observing and exploring the underwater world. They co-invented the demand valve regulator, which made the Self-Contained Underwater Breathing Apparatus (SCUBA) reliable.

The acronym SCUBA is used to describe autonomous diving with an independent air supply. It was initially developed for military use and used later for professional activities. SCUBA was than extended to recreational divers, advertised for the first time through Skin Diver Magazine in the 1950s and become popular through coverage by the media and films. The magazine targeted readers with a strong interest in diving-related activities (Eyles, 2005). More and more people were becoming curious and fascinated by the underwater world at this time and scuba diving eventually became an accepted recreation activity (Cropp, 1977).

During the early era of scuba diving, no rules had been settled upon among the small divers’ community; scuba diving had no restrictions (Davis & Tisdel, 1996). In the 1960s the Professional Association of Diving Instructors (PADI) was formed to compete with the dive training agency Confederation

Mondiale des Activities Subaquatique (CMAS), and a few others focused on commercializing scuba diving.

After the Second World War people started traveling more often and further afield, making a contribution to tourism growth and at the beginning of the 21st century tourists started seeking out low-impact sports tourism "adventures" in water environments, with these adventures eventually becoming niche tourism. Engaging in such niche tourism activities requires expensive equipment for comfort, enjoyment and easy use. "Gender, ability, ethnicity, socio-economic, and cultural background were substantive limiting actors along with social, religious, and political influences" (Jennings, 2007, p.1).

Scuba diving became more popular and more widely available at the destinations suitable for the activity. In 2001 the World Tourism Organization (WTO) estimated there to be 6 million certified divers, of which around one third were originally from European countries, followed by the United States of America and Australia (WTO, 2001). In addition, Tourism Queensland (2003) estimated there were 5 to 7 million active divers in the world, with 2.5 million in the U.S., approximately 100,000 in the U.K. contributes, and 34,600 in Australia. Ina study conducted in South-East Asia and Francophone countries of the Indian and Pacific Oceans, Depondt and Green (2006) calculated annual totals of 107,320 and 69,150 divers, respectively.

"Scuba diving tourism refers to persons traveling to destinations with the main purpose of their trip being to partake in scuba diving. The attraction of the destination is almost exclusively related to its dive qualities rather than any other factor, such as the quality of accommodation or land-based attractions".

Scuba diving tourism presented by the WTO (2001, p.85).

Diving tourists like to explore the aquatic environment in various ways; there are scuba divers, snorkelers, free divers, snuba and for more adventurous participants, there is the rebreather. When enjoying their free time at the destination it is normal for them to participate in more than one diving-related activity.

Tourism Queensland (as cited in Jennings, 2007) stated that diving tourism takes place when individuals travel to a destination where at least one

scuba dive is included. A contemporary interpretation for diving tourism, defined by Garrod and Grőssling (2008, p.7), based on the WTO, takes into account popular diving-related activities and motivation for traveling:

"Diving tourism involves individuals traveling from their usual place of residence, spending at least one night away, and actively participating in one or more diving activities, such as scuba diving, snorkelling, snuba, or the use of rebreather apparatus."

Table 1.1: Cater's possible continuums of diving-tourist motivation.

Mainliners–Sideliners	Those for whom the motivation to travel is primarily diving vs. those for whom tourism is the main motivation.
Fanatics–Dabblers	Those for whom diving is central to their lifestyle vs. those for whom it is peripheral.
Experienced–Novices	Those who have made many dives vs. those who are new to diving.
Highly qualified–'Try' divers	Those who are highly trained vs. those who are completely untrained.
Specialists–Generalists	Those who specialize in one diving activity, e.g., underwater photography vs. those who like to participate across the full range of diving specialties.
Mariners–Socializers	Those primarily interested in marine encounters and experiences vs. those putting a high value on social contact and interaction.
Independents–Group divers	Those diving by themselves or with a partner vs. those preferring to dive in organized groups.
Learners–Enjoyers	Those trying to expand their knowledge of marine environments vs. those who are primarily interested in the dive experience itself.
Homies–Remoties	Those regularly and mostly diving at home vs. those diving abroad, often in remote locations.

Note: Cited in Garrod & Grőssling, 2008, p.20.

Tourists can be classified according to their level of expertise, which can be determined by their timing spent at a certain destination. Garrod and Grőssling (2008) referred to occasional divers who have different motivations for traveling and might participate in scuba diving only if is available at the destination. WTO (2001) and Davis and Tisdell (1995) called this group of divers "sideliner divers" and "resort divers", respectively.

Following tourism trends, dive tourists choose a diving destination based on their preferences and motivations. Divers might have different motivations for traveling and engaging in scuba diving activities. Cater (2001) suggested a scale for diving tourists' motivation (see Table 1.1) and their particular interest and expertise.

Global tourism takes divers to coastal areas of the United States, Australia, Japan, the Red Sea, the Maldives, the Seychelles and the Philippines (Davis, Harriot & NacNamara, 1995). The Caribbean Sea, Pacific coast of Central America, Pacific Islands, Papua New Guinea and other destinations in Asia are also areas of biodiversity and therefore diving grounds (Musa, 2003). Coral reefs grow in environments of clear water and tropical areas where biodiversity provides attractive conditions for flourishing scuba diving activity. In Australia in1989, dive tourism was responsible for 239,000 international visitors and in 1996, approximately 100,000 Australians received their diving certification (Tourism Queensland, 2005). "The Australian recreational diving market has been estimated to be worth $1 billion from international visitors and $547 million from Australian divers; around 5% of international visitors dive during their stay in Australia and about 0.5% of Australian domestic travellers dive while on holiday. The Great Barrier Reef situated offshore from Queensland is a stopover for 93% of international divers visiting Australia and around 40% of domestic diving holidays in Australia. The Great Barrier Reef Marine Park, Queensland's most popular diving destination attracted over 1.8 million visitors in 2002 and generates approximately 1 billion Australian dollars from reef-based tourism each year" (Tourism Queensland, 2003, p.1).

Diving destinations such as Palau are very popular for scuba diving holidays, in particular for shark-diving activities. The recent trend of shark tourism produced some studies into the species and the economic benefits for the local populations, which depend strongly on an active promotion of the tourism destination. According to Graham (2004), whale shark watching

(Rinchodon typus) was estimated to have generated 47.5 million USD worldwide. The shark industry has grown much more; Topelko and Dearden (cited in Vianna, Meekan, & Pannell, 2010) reported that approximately 500,000 divers had participated in shark-diving activities. In South Africa, Hara, Maharaj and Pithers (2003) estimated the annual revenue from cage diving with great white sharks (Carcharodon carcharias) to be around 4.1 million USD and with tiger sharks (Galeocerdo cuvier) around 1.8 million USD in 2007 (Dicken & Hosking, 2009).

According to studies carried out by DEMA (2012) for the Caribbean coral reefs including Florida, recreational scuba diving has generated around 2.1 billion USD, from of 4.56 million visitor-days per year. Diving is also responsible for 26,000 full-time jobs related to the activity, and in 2009 Florida took in around 20 million USD from locals taking diving courses, purchasing equipment and utilizing services related to scuba diving.

Today scuba diving is a popular activity with more and more people engaging in it every day; some do so out of curiosity, others just to try it, while for some others it is an addiction. Events for the water sports and travel industries like the Diving Equipment & Marketing Association (DEMA) Show, organized since 1977 in the United States of America, and the Boat Show in Germany, organized since 1969, can attract a multitude of visitors looking for the latest equipment, technology, and also new travel destinations. The German “boot Düsseldorf” is the world’s biggest yachting and water sports expo. Both events run water-related activities based around beach culture and cater for families and friends, divers, and other types of tourists with different motivations for going on holiday. During the events, seminars are held by scientific teams and marketing gurus which reveal data gleaned from the Ultimate Research, sustaining the reason why scuba diving and related activities are so important nowadays.

Scuba diving has developed to the point that international training agencies have raised their certification standards, and improved their teaching methods and materials in order to be more accessible, safe and fun. Figure 1.1 shows the total number of certified divers from the three most popular training agencies, which are the leaders in the diving market. Until 2007 the number of awarded diving certifications remained quite constant, representing the highest numbers of the last eight years, but economic factors such the American

economic bubble from 2006 to 2008 forced the level of certifications to decrease by 9,335 certifications per year worldwide. One third of active divers, estimated to be Europeans, also contributed to the declining number of diving certifications, reaching its lowest in 2009. This was attributed to the easy credit conditions offered by banks that were in difficulty, affecting all of the economy. The sequence of complex factors, which every European country was living under at that time, negatively affected the whole of the tourism industry, in particular scuba diving.

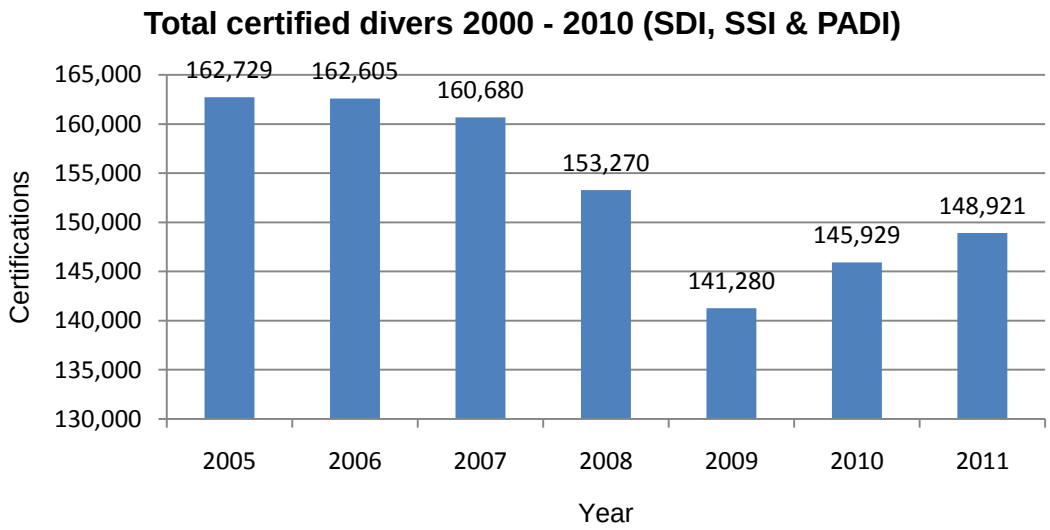


Figure 1.1: Represents total entry level (Open Water certification) compiled from SSI, SDI, and PADI Certified Diver Files. Source: DP Research Solutions (as cited in DEMA, 2013).

Diving-related activities have become popular, but overall, people have chosen scuba diving and snorkelling as their preferred activities (Orams, 1999). Water-related activities are the ones moving more people around the world, but there is a lack of representative data to back up the numbers. It is known that snorkelling involves less equipment and is more affordable than scuba diving, although Lindgren, Palmlund and Wate (2008) observed a connectivity between both activities, triggering participants to engage in scuba diving.

Since 1992, the Professional Association of Diving Instructors (PADI) has issued more than half a million new certifications per year, toping more than 21

million since it came into existence (PADI, 2013). The WTO estimated there to be 6 million divers (WTO, 2001) in the same year, and predicted that there would be “10 million active divers by 2005”. Cater and Cater (2001) predicted a much higher number of 28 million.

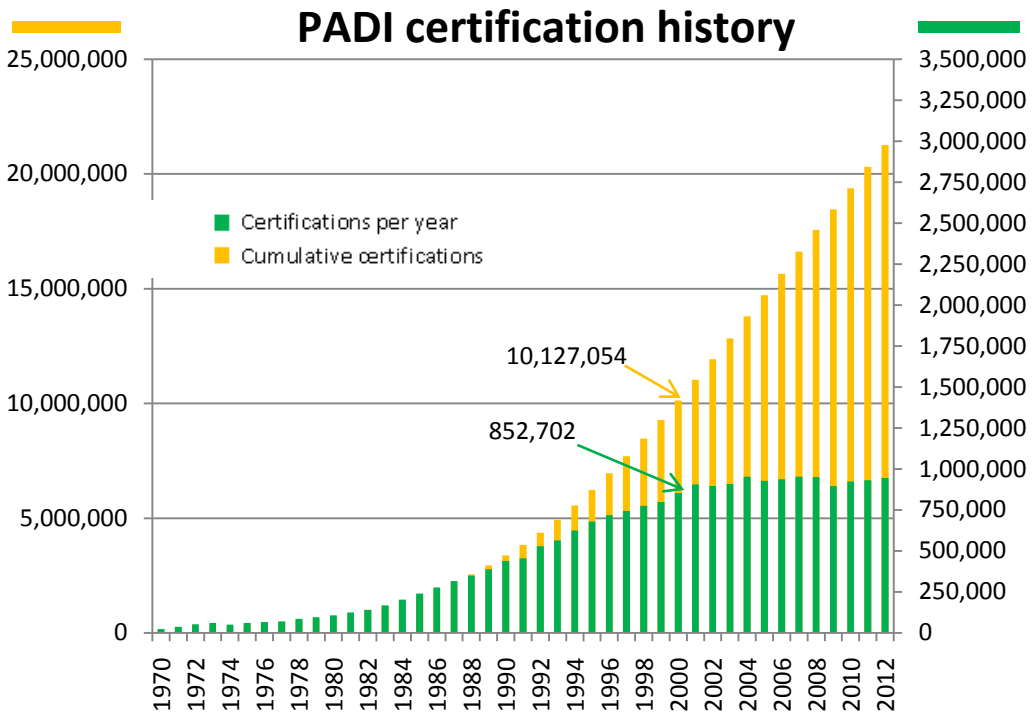


Figure 1.2: Represents total entry level and continuing education diving certifications history, for all PADI offices combined. Divers may have multiple certifications. Source: Global Certifications & Membership Statistics, adapted and used with the express permission of PADI (2013a).

Authors have profiled tourists based on their participation in diving activities. Rice (as cited in Jennings, 2007) classified three groups of divers: potential divers, with scuba experience only if it is available at the destination; diving tourists, who go scuba diving while on holiday and select destinations where it is available; and hard-core divers, who choose their destinations based on the quality of diving conditions.

Tourism demand for recreational diving has increased between the first two categories (potential divers and diving tourists) where safety has increased, when compared to the more complex planning required for technical diving.

According to Jablonski (2001), the latter type requires decompression procedures before surfacing from tasks or overhead environments.

The most popular training agencies in the last 30 years were PADI and Scuba Schools International (SSI) (Davis & Tisdell, 1995). The normal procedure for enrolling in a diving training program is to visit a diving school or club either locally or at the tourist destination to be introduced to the theoretical parts of the program. Taking advantage of new technology, dive-training agencies have also developed online lessons that can be taken at your own time and convenience, but the practice part must be carried out with the direct supervision of a qualified diving instructor. Tourists' motivation for traveling can vary but dive-training programs can be found in more than 110 countries, and materials printed in at least 25 different languages (SSI, 2013). The agency leader PADI is represented in more than 180 countries and its courses available in at least 26 languages (PADI, 2013). A full diving certification course can be completed in a quite a short time (2 to 4 days). Diving at beginner's level is limited to depths of 12 to18 meters depending on the program and age of participants. Diving with a "buddy" when training is always required in non-overhead environments (PADI, 2013). Further education makes divers more capable and responsible (Jablonski, 1999).

The international training organizations follow national and international standards for scuba diving, issuing personal certifications based on the individual's performance. Inglis, Johnson and Ponte (1999) described the majority of these certifications as being awarded at locations with tropical latitudes where reefs are more attractive to visitors. Diving is also gaining in popularity for exploring ship wrecks, kelp beds and even exploring submerged caves (Edney, 2006). Moreover, scuba diving carries risk, which can have dramatic effects if rules and procedures are not followed (Coxon, 2006).

The whole process focuses on education, equipment and experience depending on the market the operator wishes to cater to. Commonly the three components are present in every operation, but the industry has become so specialized that some focus on only one.

Scuba diving can offer the chance to remain underwater for longer periods, compared to free diving. Divers can engage in specific activities like underwater navigation, wreck diving or even the currently fashionable digital underwater photography (PADI, 2013).

1.1.2. Aspects of diver profile

Important attributes for choosing a dive location include “clean water, good visibility, plenty to do and see underwater, good diving facilities (close to dive sites) and dive centre staff who speak the diver’s language” (WTO, 2001, p.86).

The majority of divers are male (Ditton & Baker, 1999; Mundet & Ribera, 2001; Musa, 2003; Tourism Queensland, 2006), which is thought to be associated with image and the physical strength required for handling diving gear. Sometimes it is related to comfort in lower water temperatures.

Divers were studied for their behaviours while attending a conservation education program to develop “ownership and stewardship” towards the marine protected area held at the Flower Garden Banks National Marine Sanctuary in the USA. Divers were aged 18 to 65 years old, of which 70% were male and 30% female (Belknap, 2008).

In Mundet and Ribera’s (2001) study divers on the Spanish Costa Brava working in middle-to-high-level professions were 31 to 45 years old, and in studies conducted by Doyle (1996) at the Julian Rocks Aquatic Reserve in Australia, divers were aged 20 to 30 years old.

As new tourism destinations opened up, offering more adventurous and exotic activities, greater numbers of women started to go scuba diving and according to Musa, Kadir and Lee (2006) were “balancing the scale” as already 53.1% of divers in Layang Layang, Malaysia were women.

The most active divers in the US were profiled in a study organized by DEMA (2006) targeting lifestyle and demographic variables. More than 300,000 divers were “geo-coded” defining a new universe and distribution within borders. An online survey for describing activity levels and demographic variables for the same study, was returned by more than 3,000 responding divers aged from 38 to 53 years, of which76% were male. Furthermore, the dive training agency PADI (2013) released online data showing that 66% of the 945,107 new certifications in 2012 were male (see Figure 1.3). The median age for new certified divers was 29 years old.

From the 80,000 tourists visiting Palau, Anon (as cited in Vianna et al., 2010) concluded that 51% were divers, and the study conducted by Vianna et al. (2010), characterized the divers’ demographic profile as 36% Europeans,

followed by 33% from Asian countries with Japan leading with 23%, U.S. divers 21%, and Australians 7%. In this study, 58% of the divers were male, and 42% female, aged from 31 to 50 years old (59%), and divers aged over 50 years old were also well represented (22%).

Divers had a minimum of 50 dives, but 57% had at least 100 logged dives, and 75% were interested in shark-diving experiences. The divers had spent an average of 5.6 days in the water with an average stay in Palau of 8.1 days. Two thirds of those surveyed had an annual average income of more than 50,000 USD, and had spent on average 2,081 USD per trip. Vianna et al. (2010) estimated the diving-related annual income for Palau to be82.8 million USD, representing 59% of its tourism revenue. Annual taxation income amounted to 517,500 USD and income from sharks alone 179,000 USD per year.

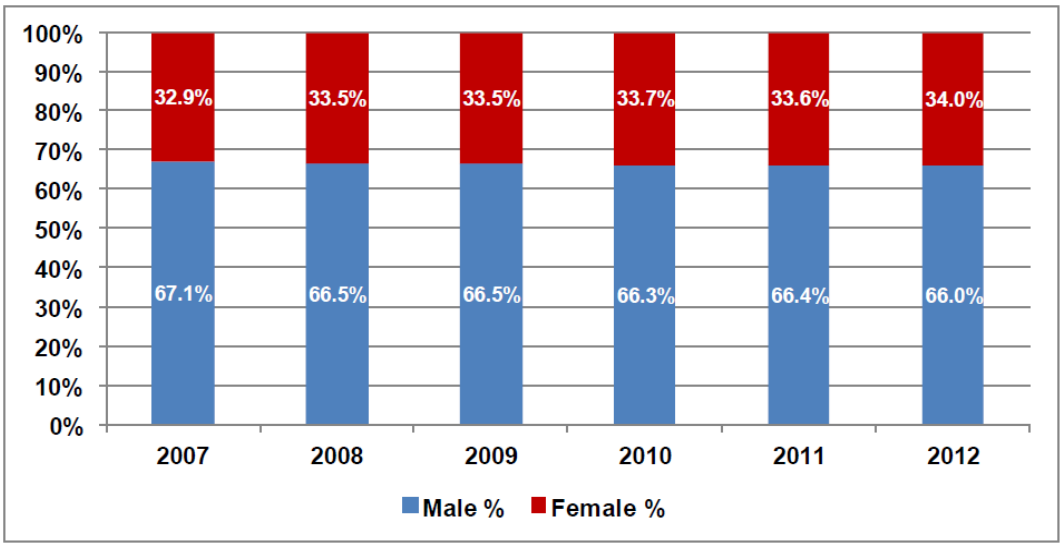


Figure 1.3: Represents total entry level and continuing education for diving certifications by gender, for all PADI Offices combined. Divers may have multiple certifications. Source: Global Student Report, used with express permission of PADI (2013a).

Obtaining a scuba diving license requires training from a diving organization, recognized by the Ministry of Sports or an equivalent national institution. The activity is than regulated for good practices, standards and national levels. International organizations like PADI or SSI, among others, can provide training programs in at least 25 languages and offer several training levels, where student divers can practice for specialty courses.

Authors like Garrod and Grőssling (2008) referred to the deficiency of research on scuba diving, and therefore the data presented can only be representative of that particular area of study (see Table 1.2). Authors identified at least three levels of expertise: Novice or Beginner is seen as the level where divers make their first steps to discovering the marvels of the underwater world. At this stage it is normal to have divers experiencing issues regarding buoyancy control and a lack of spatial awareness.

Table1.2: Studies representing diving education level of visitors to diving grounds.

Author	Place of Research	Diving level
(Belknap, 2008)	Flora Banks, USA.	24% Master 42% Advanced 34% Beginner
(Musa et al., 2006)	Layang Layang, Malaysia.	51% Experience 37.8% Intermediate 8.2% Novice
(Grőssling et al., 2004)	Mauritius.	8.2% Novice
(Contrel & Meisel, 2004)	Florida, USA.	46% Advanced 39% Intermediate 25% Beginner
(Mundet & Ribeira, 2001)	Medas Islands, Spain.	57% Advanced 23.4% Intermediate

Note: Adapted from Garrod & Grőssling (2008) and Belknap (2008).

Intermediate-level divers have spent some hours submerged, having experienced different diving spots and conditions. They are very comfortable when diving. This level can comprise open-water-certified divers who can maintain good control of their buoyancy and have a skill set comparable to advanced-certified divers, or are in possession of specialized certification in scuba diving such, digital underwater photography, or peak performance buoyancy, etc. When a diver has an advanced-open-water certification or

equivalent, he or she can descend to a maximum of 30 meters according to the PADI standard recommendation, and has experienced at least 5 disciplines of diving such as underwater navigation, night diving, and peak-performance buoyancy. The last level of expertise– Master, Experience or Advanced diver– is assigned to divers with many hours of scuba diving experience in different conditions, and as well to technical divers and professional recreational divers.

It is common that divers have been trained in emergency first-response and rescue diving techniques, specialties for underwater photography and video, fish identification, etc. Only PADI offers more than 20 speciality diving courses and technical diving training.

Open- water scuba diving should be done in accessible areas where safety procedures can be used followed when required, ranging from shores, lakes, lagoons, dams, rivers or quarries to open- sea locations accessible by boat. In some areas, liveaboard boats, on which divers can remain overnight at sea, represent a good alternative to access certain diving grounds that take longer to reach; however, prices are quite high compared to land-based operations.

The divers' profile does not match that of general international travellers as scuba divers are quite wealthy, aged 20 to 40 years and employed. 80% of divers in the United States are under 50 years old, while only 47% of international travellers are aged 20 to 40 years. Also 78% of divers are full-time employed. With an average income of $80,000 US divers earn more than the average international traveller. "One in three divers take foreign diving holidays while the most ardent diving enthusiasts will take multiple diving holidays every year or will take a specialist diving holiday on their own plus a second holiday with the family" (WTO, 2001, p.86).

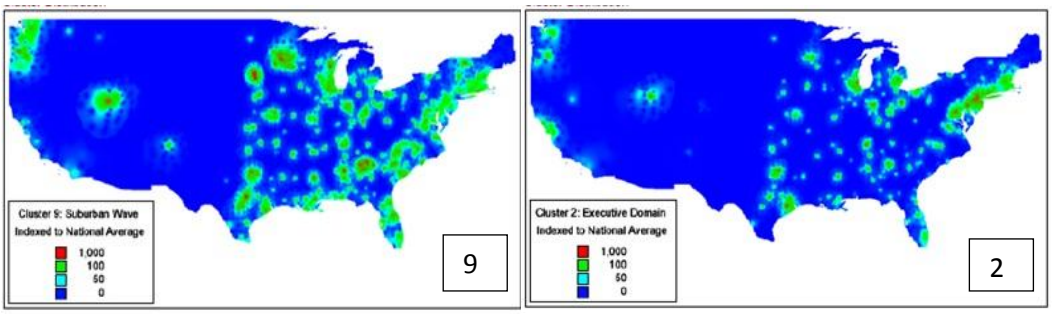
Some authors noted the tendency of a high relation between divers' income (see Table 1.3) and the activity, which has high costs for equipment purchase, travel, accommodation and further diving education. Furthermore, scuba diving becomes more exciting and pleasant when new diving grounds are visited.

Table 1.3: Findings for divers' average annual household income.

Author	Household income per annum (USD)
(Vianna et al., 2010)	$50,000 – $79,999
(Todd, 2004)	$60,000 divers in New York, USA.
(Grőssling et al., 2004)	$73,000 – $96,000 for divers and snorkelers in Mauritius.
(WTO, 2001)	$80,000 for American Diving tourist.
(Ditton & Baker, 1999)	$60,000 – $69,000 for divers on the artificial reef in Texas, USA (81% from Texas).
(Tabata, 1992)	$64,000 for respondents of Diver Magazine in 1989. $35,000 average for Americans US.

Note: Adapted from Garrod & Grőssling (2008).

ADEMA (2006) study reported that divers could be found spread across the country and not necessarily only at coastal areas (see Figure 1.4). The clusters are based on the diver's activity and median household income, and it was reported that 56% of participants made between $75,000 and 100,000 per year. Authors such as Thailing and Ditton (2003), and Todd (2004) showed a tendency for divers to have a high level of education (see Table 1.4). Scuba diving is an activity linked with economic availability that is apparently required to a medium-high degree. Higher education can be a career boost and thus lead to a higher income, which for divers means they can afford to become more active by visiting more diving areas. For top workers and managers from big corporations and successful companies, it is a professional requirement to be educated in the relevant discipline.



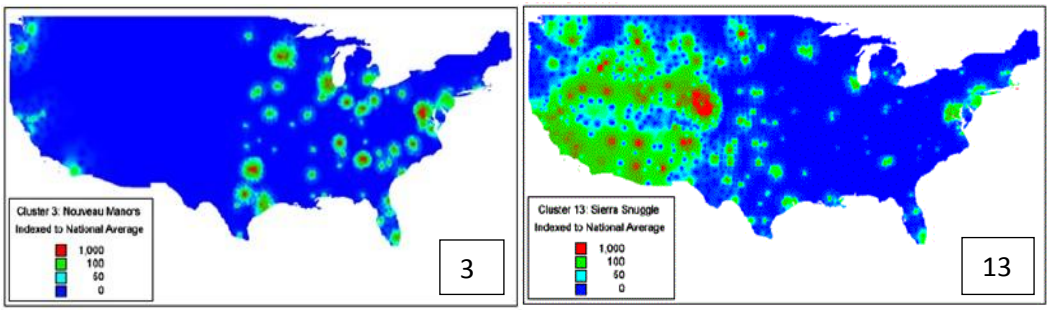


Figure 1.4: Diver geo-location in the USA, clustered by using the most active divers plus the highest median income (Clusters in order: # 9 Suburban Wave, # 2 Executive Domain, # 3 Nouveau Manors, and # 13 Sierra Snuggle). Source: DEMA 2006.

Table 1.4: Studies representing the education level of visitors to diving grounds.

Year	Finding	Reference
2009	Study conducted on the 5 most popular diving islands in Malaysia, in 53 diving centers: 10.2% Secondary education 25.2% Diploma education 43% Graduate education 19.4% Post graduate education 2.2% Other	(Ong & Musa, 2011)
2008	72% Bachelors and 28% Graduate	(Belknap, 2008)
2006	66.3% of divers in Layang Layang, Malaysia had undergone university and postgraduate studies.	(Musa et al., 2006)
2004	58% of snorkelling tourists in Mauritius had college degree.	(Grőssling et al., 2004)
2004	75% of divers from New York, USA had attended college.	(Todd, 2004)
2003	US divers in Texas had spent an average of 16 years in school.	(Thailing and Ditton's, 2003)
2003	71% of divers in Sipadan, Malaysia had some college education.	(Musa, 2003)
2001	80% of PADI's new registered divers had college education.	(Cater and Cater, 2001)
1989	84.2% of US divers had at least a college degree.	(Tabata, 1992)

Note: Adapted from Garrod & Grőssling (2008) and Belknap (2008).

Several authors recorded divers' profiles in certain areas of the globe, becoming a strength when stating that scuba diving is definitely an important activity and represents an important tourism segment. Studies by Dietz, Stern and Guagnano (1998), Jones and Dunlap (1992) revealed the socio-demographic aspects of age and education as having a considerable effect on pro-environmental behaviours when compared to other variables of the same nature.

The rising numbers of scuba divers has created an increasing demand for diving services and diving-related operations; moreover, it has raised concerns in regard to marine environment impacts (Ong & Musa, 2011). Taking part in nature-based activities can show participants how important it is to get close to nature as in today's society we tend to be disconnected from it. This form of tourism enhances the understanding of the impacts created by issues such the overuse of resources (Forestell, 1993). Authors like Lee and Moscardo (2005), Tisdell and Wilson (2005), Ballantyne, Packer, and Hughes (2007), Ballantyne and Packer (2009) confirmed both positive short- and long-term impacts on visitors' environmental learning through this kind of tourism experience. Furthermore, it can also have positive impacts on the environment itself; however, there is also the potential for a negative effect on the species and ecosystems. It is very important for tour designers and wildlife tourism managers to ensure good practices and ethics for education in nature (Ballantyne, Packer & Sutherland, 2010).

Zhong, Deng and Song (2011) described direct relations between tourism activity, local society and the use of natural resources, pointing out both positive and negative aspects of progress. Since 1978, when China opened its borders for tourism development, tourism has grown substantially but has caused substantial environmental problems. Also well as registering cultural losses, tourism activity is also endangering the local sustainable development of the tourism industry. Considerable impacts occurred in the biophysical environment, affecting the water quality grade by increasing the volume of wastewater and garbage produced.

A common strategy for increasing wildlife encounters, facilitating close observation of species, is by feeding animals; the practice disrupts the animals' natural behaviour, affecting population levels (Orams, 2003, p. 281). The animals were found to be strongly dependent on the food provided by visitors

and consequently sought habituation close to human proximity. The author highlighted a repercussion of this in the case of “two dingoes that have mauled a nine-year-old boy to death and bit his seven-year-old brother” on May 1, 2001, on Fraser Island, Australia. His work approached aspects of the impacts caused on wildlife species where there is a noticeable modification of their natural behaviour, leading to dependency on and habituation close to the presence of humans, reported aggression towards humans, health problems and injuries.

Humans feel attracted to wildlife interactions, probably due to nature coverage by environmental-based media and magazines; Orams (1996) stated a few perspectives on such attractions and on-site management procedures.

1.1.3. Diving tourism and impacts on nature

Nature-based tourism is commonly associated with educational components in natural and protected areas, as a form of balanced interaction with distinctive species, culture and societies linked to the natural environment. Such an association has become popular through wildlife interaction (Orams, 1996; Moscardo & Saltzer, 2004; Ballantyne et al., 2007; Garrod & Grőssling, 2008; Santander & Propin, 2009; Minnaert, 2012) in places considered for low-impact tourism where adventure tourism and ecotourism take place, and visitors can learn from their experiences (Falk, 2011).

According to Newsome, Dowling and Moore (2004) wildlife tourism describes a method of encountering wildlife that takes place in natural or artificial environments where visitors can observe and sometimes interact with animals. Such encounters can cause impacts, both positive and negative for the wildlife. The most common positive impact is the protection of species through economic and non-financial contributions (Powel & Ham, 2008).

When used for environmental education, wildlife encounters were described by Ballantyne, Packer, Hughes, Dierking, Lee, Moscardo, Tisdell, Wilson, Zeppel & Muloin (as cited in Ballantyne et al., 2010, p. 771) as activities that contribute to:

I. Developing respect and appreciation for wildlife and nature;

II. Raising awareness of environmental issues;
III. Promoting environmentally sustainable attitudes and actions;
IV. Building tourists' capacity for the longer-term adoption of sustainable living practices;
V. Providing income for the ongoing protection and sustainable management of wildlife and their habitats (Wells, 1997; Goodwin, Kent, Parker, & Walpole, 1998; Fennell, 1999; Wilson & Tisdell, 2001; Buckley, 2002; Zeppel & Muloin, 2007);
VI. Encouraging visitors to make financial and non-financial contributions to environmental causes (Powell & Ham, 2008);
VII. Providing socio-economic incentives for the conservation of natural resources (Schänzel & McIntosh, 2000; Higginbottom, Northrope, & Green, 2001), and
VIII. Influencing tourist behaviour during a visit (Medio, Ormond, & Pearson, 1997; Orams & Hill, 1998).

In certain coastal areas, the whole community is dependent on the water environment for living, so preserving coral reefs and the marine ecosystem are very important (Howard, Musa: 1999, 2003). Locally, diving creates the opportunity to develop and change the environment (Rouphael & Hanafy, 2007) and at the same time promotes Marine Protected Areas (MPA's) and conservation of species. The revenue collected from diving-related activities can easily be used to sponsor management work and tools for "boosting" natural resources (Roberts & Hawkins, 2000), becoming even more attractive to tourists in the process. Local economies can benefit from diving tourism and "preserve the local environment" (Weaver & Opperman, 2000).

Economic impacts are also present with tourists exchanging foreign currency to spend on local goods, art crafts and services, and "Jobs can be created to support tourism activities" (Leiper, 2003, p.139).

Negative impacts on animal life include the possibility of injury, distress, disruption of natural behaviours and breeding partners, pollution or the destruction of habitats (Green & Higginbottom, 2001; Higginbottom et al., 2001; Reynolds & Braithwaite, 2001; Green & Giese, 2004; Newsome et al., 2004; Constantine & Bejder, 2007).

Moscardo and Saltzer (2004) found a relation between tourists watching rare and exotic wildlife from close proximity with an increase in their learning about the animals and their behaviour, and as well contributing to the visitors' satisfaction. These actions also carry additional negative impacts for the ecosystem. When animals find the natural course of life disrupted and become used to the presence of humans, Constantine and Bejder (2007) observed a disturbance in reproductive success. Reynolds and Ballantyne (2001) detected negative impacts caused by management actions and pollution.

Along coastal areas new facilities to accommodate visitors have been developed that are taking over the shoreline, and interfering with natural habitats and coastal hydrodynamics. The expansion of such areas has become crucial for local development, but ecotourism has led to coastal stress and disrupted the natural process of the sea turtle (Tisdell & Wilson, 2002).

Garrod and Grőssling (2008) revealed an increase in nature-based tourism for animal watching for species such as dolphins, whales, manatees, potato cods, whale sharks, penguins and turtles (Baxter, 1993; Orams, 1994).

Interactions with wild animals cause impacts, which can turn negative when conservation becomes "product exploitation". Confining animals to their habitats can offer the chance for tourists to break important rules regarding animal interaction like touching or riding them. Conservation increases the number of specimens in an area making it a bigger attraction and almost guaranteeing that visitors will see the animal they came to see (Orams, 1996).

Forestell and Kaufman (1990) reported the same for whale watching in Hawaii and Shackley (1990, p.316) argued that "anyone who wants to ensure the survival of the species would be well advised to avoid visiting them". The same authors found high visitor numbers and manifested their concerns about the cumulative effects and potential impacts, and disruption to the natural process: "Tourism creates more tourism, the location becomes well known and thus desirable creating demand, more supply and ultimately destruction of the original reason for going there" (Zell, as cited in Orams, 1996, p. 83).

Diving tourism destinations can cause negative impacts across society and affect local culture through the behaviours, lifestyles or attitudes introduced by visitors (Leiper, 2003). Foreign investments boost local economies based on diving-related activities, requiring further development in infrastructures, allowing

populations to grow. However, Dimmock (2007) suggested negative impacts on the local population due to foreign ownership and tourism control.

Authors cited the example of the Red Sea area of Israel and Jordan, where the result of land reclamation carried out to facilitate tourism development was “a loss of social amenity for those involved that includes crowding, congestion, and inconvenience” (Inglis et al., 1999; Bushell, 2001, p.138).

Musa (2003) referred to the poor control of visitors on Sipadan, which has resulted in overcrowding and noisy generators affecting tourism. Orams (1999) stated that negative economic impacts can arise when tourists destroy the attraction by overusing the resource, going beyond its natural limits. Prices go up, restricting local participation, thus increasing negative social outcomes,

On the environmental side, marine tourism can bring about the creation of new infrastructure like marinas, pontoons and accommodation along the coast. An impact can be generated by services for tourists (Moscardo, Pearce, & Green, 2001). Labuda (1981, p.139) highlighted environmental impacts in areas with “slow water movement such as lakes or lagoons”. He also noticed an accumulation of pollutants from motorboats, including hydrocarbons and lead compounds. ”Boat engines with more than 25 Hp stir up water layers and can damage aquatic life”, especially during spawning.

In marine ecosystems damage can be done to coral reefs through fining (Davis et al., 1995), touching the coral with the scuba tank, reef walking, touching and stirring up sediments from the bottom (Hawkins and Robert, 1992), paint scraping, crushed coral, holding on to coral and standing on the bottom (Rouphael & Inglis, 1997).

As stated above, diving has become popular and has developed communities in certain regions of the planet. To visit such places, which are usually in tropical, temperate and sometimes Arctic latitudes, travellers use long-distance flights. The energy required to fulfil such “need” associated with accommodation and high-consumption boat engines, enlarges the ecological footprint for diving tourism. At the destination it is common to use powerboats to reach dive spots, and Garrod and Grőssling (2008) expressed concern about the difficulty of measuring such impacts.

Recreational industries are committed to reducing impacts through environmentally friendly diving and snorkelling products. Diver skills and

education have been targeted for commercial use and access to interest groups (Dimmock, 2004).

"Regular monitoring of both biophysical and social dimensions of involvement is required to manage impacts of the activities from a holistic perspective" (Dimmock, 2007, p.141)

Impacts caused by nature-based tourism have been studied in regard to social, cultural, environmental and economic activities. Apparently development is associated with economic return and impacts might be both positive and negative. There is also the need for managing natural resources and reducing foot prints by educating local populations and visitors about the importance of good practices and use in order to leave a legacy for future generations.

1.1.4. Marine debris

In 1975 the National Academy of Sciences recognized marine debris as any material produced, discarded or abandoned by humans, and reaching the oceans by any means. Usually it flows into the sea from streams or rivers, but it can also be carried by the wind from coastal areas or dumped from vessels.

Marine debris has several origins and according to Williams et al. (2005) they can be classified according to their source. Waste can be created on land, ending up in water streams, rivers, lakes, seas or oceans, or originate from vessels, farms or any offshore installation. Debris can be carried by water currents to anywhere in the world. The wind plays an important role as a vector for dispersion, and underwater currents are responsible for its transportation and settlement on the sea bed (Hinojosa & Thiel, 2009).

Martins (2011) reported that plastic could be collected by beach cleaning, ocean-monitoring programs and collections carried out for research purposes. Each year there are reports of millions of animals being affected by litter reaching remote places where there is little or no civilization, like for example the Antarctic waters. After analysing several studies conducted on the western US coast line, Moore and Allen (2000) determined that ocean-based marine debris sources are most likely drifting to the North East Pacific area.

Reported impacts from marine debris include entanglement of marine species in fishing nets, pollution of the marine environment, aesthetic and detrimental effects on coastal economic activity. The photodegradation of plastic and mechanical abrasion breaks the debris down into smaller pieces affecting animals that inadvertently ingest it. Animals suffer from the bioaccumulation of toxic pollutants (Persistent Bioaccumulative Toxics as polychlorinated biphenyl – PCB and diclorodiphenyltricloroethane – DDT and plastic additives).

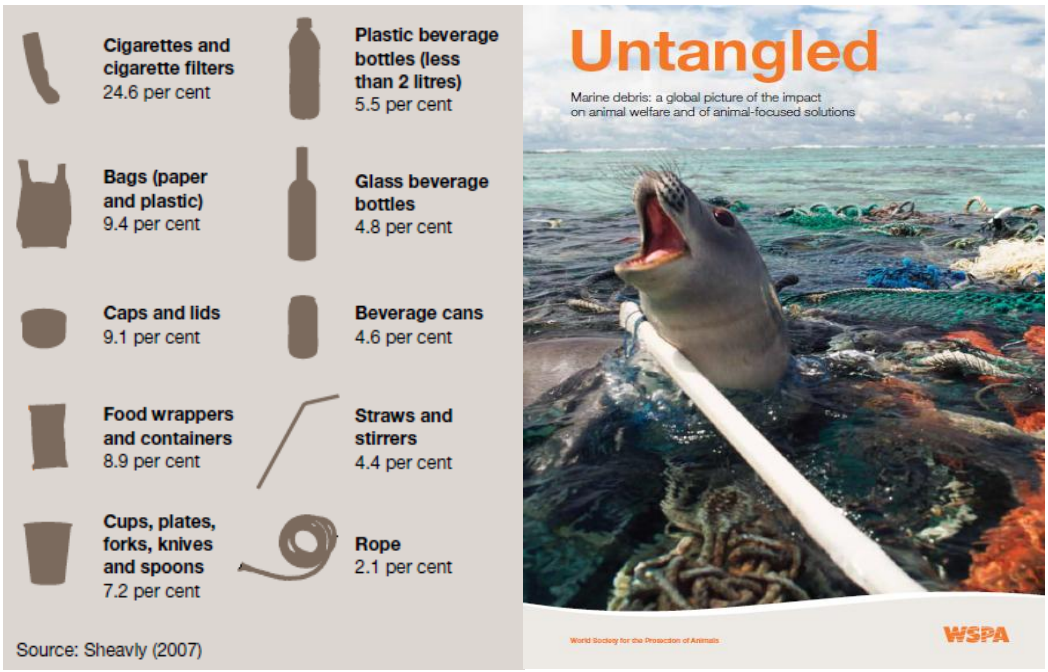


Figure 1.5: The ten most prevalent marine debris items (from 1,003,247,609 items collected), referring to the period 1989-2007 (WSPA, 2012).

Litter has become a threat to animals and structures (see Figure 1.5) influencing the natural habitats, feeding behaviour and reproduction of species. The WSPA (2012) categorized several types of marine debris (litter) into the following:

- Fishing industry debris: rope, fishing net, fishing line, lost fishing traps and pots, floats, etc.
- Food-related waste: plastic bags, plastic bottles, cans, food containers, lids, plastic straws, food packaging, etc.

- Smoking-related waste: cigarette filters, cigar tips, disposable lighters, packs, etc.
- Manufacturing- and shipping-related waste: plastic resin pellets, pallets, plastic sheeting, strapping bands, straps, etc.

During a cleaning of US beaches, monitored by the US National Marine Debris Monitoring Program (as cited in WSPA, 2012),it was observed that 32.3% of the litter had the potential to harm wildlife, with the 5 most common items being plastic bags, balloons, rope longer than 1 m, fishing line and fishing nets.

Gregory and Andrady (2003), and Ivar do Sul and Costa (2007) referred to the existence of marine debris in every ocean and coastal water environment, along with the major shipping routes and proximity to major urban sites (Matsuma & Nasu, 1997; Thiel Hinojosa & Vasquez, 2003), those debris travels through the major ocean currents (Kubota, 1994; Shiomoto & Kameda, 2005).

Cited on Hinojosa & Thiel (2009) impacts on marine life can be classified as:

Table 1.5: Classification of impacts on marine life.

Classification	Description	Author
Entanglement	Usually caused by fishing lines, ropes, cables or “ghost nets” in the water.	(Boren et al., 2006)
Ingestion	When mistaken for food due to its color, shape or size.	(Ryan, 2008)
Transport of associated fauna	Including non-native species, becoming then invasive.	(Barnes & Milner, 2005)

As early as the 1970s vessels sailing the oceans reported sightings of floating marine debris. Environmental legislation was then created to set more effective measures for dealing with it, and maritime laws and conventions were passed like Marpol 73/78, from the International Convention for the Prevention of Pollution from Ships. It was now forbidden by law to dump in coastal waters, oil

and exhaust pollution were targeted, and pollution from ships was minimized (Hinojosa & Thiel, 2009).

The environmental impacts from fish farming must be considered, as it causes a high amount of nutrients to be released into the water which eventually reaches the natural environment – open water– at which point it becomes invasive for species (Correa & Gross, 2008). On the Chilean coastline, fish farming represents 99% of national production, and according to the FAO and SERNAPESCA (2007) it is ranked 2nd and 4th in the world for salmon and mussel production, respectively.

A study on marine debris carried out in Chile during winter in 2005, emphasized items used to delimit fishing farms and keep lines afloat, as credible causes of pollution. The most common materials found included: Styrofoam, plastic fragments, plastic grocery bags, lines, food sacks, wood tables, bottles, tetra pack, plastic cups, cigarette boxes, etc. Hinojosa and Thiel (2009) found that 80% of marine debris was made from Styrofoam. Comparable findings were made by Matsumura and Nasu (1997), who reported that 70% of debris in Eastern China was Styrofoam, and Fujieda and Sasaki (2005), who calculated 99% for Hiroshima. These studies highly suggest that sea-based activities as responsible for the majority of Styrofoam debris found in Chilean fjords (Hinojosa & Thiel, 2009).

Countries with coastal areas have started to monitor plastic debris, although small debris (<20 mm) is difficult to study due to its size, with the knock-on effect that its impact can also not be determined (Ivar do Sul & Costa, 2007; Sheavly & Register, 2007; Moore, 2008; UNEP, 2009). Martins and Sobral (2011) have carried out a study focused on sizing plastic debris on the Portuguese coastline through cleaning beaches of stranded plastic debris, and analysing beach sediment. They discovered small plastic debris and addressed the need to deal with the current problem due to chemical implications of a high concentration of PBT contaminants, higher PCB concentration in aged polyethylene pellets, and DDT, PCB and polycyclic aromatic hydrocarbon (PAH).

Distance from source, form of debris, physiography and direction the beach is facing, are important physical factors affecting the distribution of marine debris. Moreover, meteorological factors like wind direction and intensity can be determinative at the time of sizing superficial waves and water movements (Debrot, Tiel & Bradshaw, 1999).

The sampling period can be more effective at equinoctial high tides and predominant currents, guaranteeing more accumulated debris, and according to Gregory (2009), smaller sand-grain size can favour debris accumulation. Studies for small marine debris were conducted in different parts of the world, at different times, recorded in Table 1.6 below:

Table 1.6: Plastic debris found in research, recorded during international studies.

Author	Size	Plastic debris	Location
(Moore et al., 2001)	1 – 2.8 mm	61%	California
(McDermin & McMullen, 2004)	2.8 – 4.75 mm	48%	Hawaii
(Moret-Fergunson et al., 2010)	2 – 6 mm	69%	North Atlantic Ocean

The “Great Pacific Garbage Patch” has been researched in the last few years. Marine debris found in this “region” showed that debris accumulated on the sea floor has a potential impact on organism populations (Day, Shaw & Ignell, 1990; Lee, Cho & Jeong, 2006). Oceanic currents move across the sea floor caused by the Coriolis force, which is responsible for the rotation of the earth, and vertical movements of the atmosphere. The equilibrium occurs between tropical and polar latitudes, where gas flow changes temperature, creating wind. The thermodynamic system, balanced by the force acceleration and the pressure gradient force, gets water currents moving to the right at northern latitudes, and left at latitudes below the equator. Another important factor is the density difference of the water fluid, determined mostly by temperature, salinity and environmental pressure. Near the poles, water cools down and sinks due to its higher density; the water moves closer to the sea bead until it reaches warmer regions of the globe.

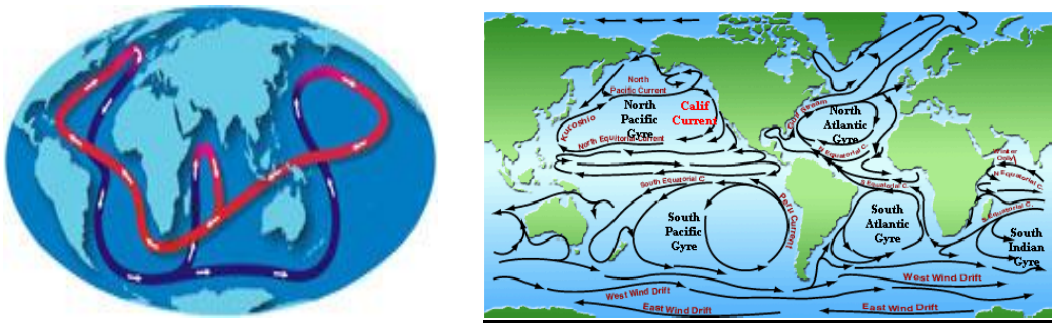


Figure 1.6: Ocean conveyor belt and the five ocean gyres. Source: NOAA 2013, and geography.com.

This natural phenomenon is called thermohaline and creates the movement of the ocean conveyor belt represented in Figure 1.6. Oceanic currents and wind can carry debris long distances from the source and cause them to accumulate at equatorial latitudes. Sheavly (2005) mentioned the Great Pacific Ocean Gyre as one of the biggest on the planet, covering an area equivalent to France and Spain combined. Garbage patches are more pronounced and cover an extensive area due to the fact of the Coriolis force being absent (Angela, 2001); oceanic gyres are found at both northern and southern latitudes.

The bar coding system used to identity products often enables marine debris to be tracked to its source. The first three digits determine the product's country or manufacturer. Santos, Friedrich and Barretto (2005) were able to track marine debris found on Brazilian beaches, as originating from several nations, see Figure 1.7.

The major issue of marine debris and the fact that the majority comprises plastic-related items led to the Declaration of the Global Plastics Association for Solutions on Marine Litter, dating March 2001. Leaders representing 34 countries met for the 5th International Marine Debris Conference in Honolulu, Hawaii (USA), and signed the declaration for tackling the global problem of plastics in the environment. At the conference participating countries were represented by 58 plastics organizations and they committed to contributing to more sustainable solutions through the implementation of six projects aiming for education, research, public policies, sharing best practices, plastic recycling/recovery, and plastic containment. Land-based sources represent 80% of marine litter with the remaining percentage (20%) being ocean based. Poor

waste management, natural disasters and fishing-related gear are the main reasons for marine debris. Around 70% of litter is submerged due to its density, but the remaining 30% floats in water environments. The problem referred to as “marine litter” gained the attention of governments and the public in general, offering the promise of legislation for the boundaries of restricted areas regarding dumping and littering. The waste issue as well is in the study for impacts and economic value.

Figure 1.7: Origin of plastic waste found on Costa dos Coqueiros beaches, Brazil (in percentage), and view of the landings (WSPA, 2012).

The Marpol 73/78[1] convention banned ocean disposals, although noxious liquid substances and not-disinfected sewage can be discharged over 12 nautical miles or more from the nearest land (IMO, 2013).“In 1988 all forms of

[1] MARPOL 73/78 (the International Convention for the Prevention of Pollution from Ships) is the international treaty regulating disposal of waste generated by normal operation of vessels. The treaty consists of 20 articles and 5 annexes. Annex V addresses the disposal of garbage from ships and includes a provision preventing the disposal of plastic at sea. http://www.epa.gov/OWOW/OCPD/marpol.html

plastic were banned from disposal on the sea, and on January 1st of 2003, the revised Annex V prohibits the discharge of all garbage into the sea, except as provided otherwise, under specific circumstances" (IMO, 2013).

Marine debris has different sources but it eventually all ends up in a water environment, contaminating and impacting wildlife, and damaging boats and structures. Action needs to be taken, and society should take responsibility for the issue. Legislation needs to be enforced and education promoted at all levels. Conscientious behaviour in the household can minimize the negative environmental effects and contribute to good waste management. Programs in schools can only help if problems are properly addressed and children pass the advice onto their families (Derraik, 2002).

An effective method for learning about the impacts of marine debris is being educated about means of prevention and acting more responsibly. At tourism destinations, the local population has the right to be informed about marine litter and possible impacts on the ecosystem. Their understanding can bring benefits for local development and better resource management. Visitors will arrive and participate in a process of experiential learning with locals, adhering to procedures and respecting codes of conduct for more responsible tourism.

1.1.5. Plastic pollution: microplastics on water bodies

Plastics can be found everywhere on the planet and often is the cause of pollution that negatively affects the whole ecosystem. The size of the debris is important when animals mistake it for food, in particular when it is smaller than 0.5 mm. A study was conducted on marine invertebrates exposed to microplastics, which are ingested and bio-accumulated in the animals' tissues. Plastic is present in all activities developed by humans, and has a broad application in different fields like medicine, commerce and industry. According to Plastics Europe (2012), in 2011 nearly 280 million tons of plastic were produced for various applications. Through many vectors, plastic accumulates in the environment because of poor practices regarding handling and manufacturing;

meteorological factors can also contribute to the depositing of plastic in water environments (Moore, 2008; Thompson et al., 2009)

Microplastics can be identified as being produced in microscopic sizes, or as a result of mechanical rupture of the material. The National Oceanic and Atmospheric Administration (NOAA) defined microplastics as any particle smaller than 5 mm. Being present in all marine environments, they reach remote areas, and are present in the water or accumulated in the sand (e.g., Moore et al., 2001; Thompson, 2004; Ivar do Sul et al., 2009; Wright, Thompson & Galloway, 2013).

Plastics tend to be carried by the water current and are found more in areas where oceanic gyres occur and near to industrial areas located along the shoreline. Goldstein et al. (2012) reported that the North Pacific Subtropical Gyre has a microplastics concentration of 32.76 particles per m^3 and 250 gm^3 mass. Furthermore, studies conducted by Noren and Naustrall (2010) found 100,000 plastic particles per m^3 of seawater in a Swedish harbour, located in the proximity of a polyethylene production plant.

Sediment from eighteen shore areas, sampled across 6 continents, was analysed and a maximum of 124 fibres l^{-1}were found, which were linked to human population density (Browne, Crump & Nivens, 2011). Goldstein Rosenberg and Cheng (2012) compared the abundance and mass of the particles and realized that from the period 1972 – 1987 to 1999 – 2010, the factor doubled. Moreover, sampling the surface waters from the North Sea and North Atlantic revealed the presence of smaller particles over the past 24 years. Apparently, smaller particles tend to conglomerate more (Wright et al., 2013).

Marine life is directly impacted by plastic circulating in the water; the impact is tremendous with animals mistaking plastic for food. Recently the plastic issue has become a target for the media, and an object of study for scientists. For example, a large animal like a Mediterranean whale (Balaenoptera physalus), which filters around 70,000 l of water at once, is exposed to the major threat of ingesting a huge amount of microplastic. The fact is that microparticles are being ingested, carrying the possibility of entering the food chain, which causes even more of an impact through bioaccumulation.

From sampling in the English Channel, Lusher, McHugh and Thompson (2012) found that 36.6% of the fish from 10 different species they examined had stomach contents of 1.9 particles of plastic in the form of fibres made from

polyamide and polyester, which are commonly found in fishing gear. Boerger, Lattin and Moore (2010) took samples from the North Pacific Central Gyre and found small fragments in one third of all the fish caught for analysis. Their stomachs contained an average of six plastic pieces in the size range of 1 – 2.79 mm (Wright et al., 2013).

Figure1.8: Marine debris found in the stomach of a fish. Source: 5 Gyres Institute, positionpaper2013. Source: http://5gyres.org/media/5_Gyres_Position_Paper_on_Microplastics.pdf

In addition, Choy and Drazen (2013) collected pelagic fish stomachs from the North Central Pacific for the Hawaiian Observer Program (2007 – 2012). The species were living at depths of 100 m and 100 – 400 m. The analysis of 595 stomachs of 10 different species demonstrated that 19% of the sample contained marine debris. Only three species were plastic-free, and 262 small plastic pieces were found inside the animals.

Possible explanations are that deep-sea fish are traveling to superficial water for feeding during the night and also that prey might have previously ingested the plastic particles, but the size of the prey was actually smaller than the plastic sizes collected. A different theory is that plastic is ingested when the fish is hauled to the boat, but this is not compatible with direct observations at sea. Another possibility is biofouling that forces the plastic to sink to depths where species are dwelling, and also atmospheric phenomena can be considered as they have the capacity to transport debris through the mixing currents (Choy & Drazen, 2013).

Polymers used in the cosmetic industry target microplastics, which were recognized by Gregory (1996) as polluting the environment in a passive manner. Such microplastics were initially used in hand cleansers, but have since been replaced by natural exfoliate materials for use in cosmetics (Sewell & Fendall, 2009). Polyethylene is the ingredient presented as “micro-beads”, “micro-bead formula”, or “micro-exfoliate” that reaches the water environment by not being filtered in the sewage system or wastewater treatment plant and negatively affects the environment.

During summer 2012, the 5 Gyres Institute sampled water from the surface of the Great Lakes (Huron, Superior, and Erie), and from dragging a 60 cm wide net for two nautical miles it sieved 1,237 microplastic particles. Together with other environmental institutes and organizations, several governments have been asked to formulate effective legislation to ban the sale and production of products containing micro-beads. European governments were asked to start work on legislation on January 1, 2014 (5 Gyres Institute, 2013).

“Microplastic particles and micro-beads can be found in facial scrubs, shampoos & soaps, toothpaste, eyeliners, lip gloss, deodorant and sun block sticks. These micro particles are made of polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polymethyl methacrylate (PMMA) and nylon. PE and PP are the most common. Many brands of facial scrubs contain micro-beads and angular microplastic fragments as seen here at 10X magnification” (5 Gyres Institute, 2013, pp.3,4).

Figure 1.9: Micro-beads in facial scrub (5 Gyres Institute, 2013).

Fendall and Sewell (2009) tested four different facial cleansers which contained polyethylene as a “micro-exfoliate”. All brands contained pieces of plastic smaller than 1 mm; some were slightly bigger, but the majority were smaller than 0.5 mm. Research has concentrated more on macroplastics affecting marine environments, in particular through landings, ingestion or entanglement, although plastic mechanical breakdown eventually becomes micro-sized and more easily ingested (Moore, 2008; Fendall &Sewell, 2009). There is a danger of potential bioaccumulation of microplastics smaller than 2 mm when ingested by filter-feeding animals (Browne et al., 2008). Polyethylene micro-beads can enter the food chain through predators feeding on smaller prey, which carries chemical bioaccumulation to the top levels of the trophic chain.

The use of plastic has become common practice for reducing the volume in the packaging, production cost, the weight of materials, becoming also energy efficient in the automobile industry (Turner et al., 2012). Contaminants adsorb the material, forming an external layer, which can be composed of plasticizers used to produce the polymer and hydrophobic organic compounds known as polychlorinated biphenyls, as well as polycyclic aromatic hydrocarbons (Mato et al., 2001; Endo Takizawa, & Okuda, 2005; Rios et al., 2007; Turner et al., 2012).

Takada (2006) studied the interactions and dispersion of resin pellets, focusing on organic contaminants attached to raw pellets used in the industrial manufacture of plastic-derivative products. The raw pellets tend to be spherical or oval-shaped, have a translucent colour when new, and range from 1 to 5 mm in size. The pellets displayed discoloration when exposed to the natural environment as the sunlight degrades the material, which likewise happens through biofouling accumulations (Endo et al., 2005).

Along several beach areas located along the west coast of England, polyethylene resin pellets were found containing traces of metal concentrations, probably through adsorption of metal bearing mineral parts to the polymer surface. Such concentrations were sometimes higher than traces found in estuarine sediments. Plastics can also be a vehicle for transporting metals in the marine environment, which can travel long distances from source and adsorb compounds that can be ingested by marine life (Turner et al., 2012).

The International Pellet Watch (IPW) monitors persistent organic pollutants (POPs) in resin pellets collected along shores around the world. Sampling is a low-cost operation as it relies on beach clean-up or selective

collection of the pellets. The international network carries out its monitoring near urban areas, non-urban areas, in the vicinity of industrial facilities, and near commercial harbours (Martins & Sobral, 2011; Takada, 2006, 2013).

Particles originate in industrial processes for manufacturing plastic-related products and due to poor handling practices; the pellets are released into the environment and carried away by the wind, animals or surface water runoff. Pellets are resistant and accumulate POPs, and serve as an indicator of environmental pollution as they can be used to study chemical entries into the food web (Takada, 2006, 2013). The same author linked these hazardous chemicals to impacts on wildlife and humans in the form of, for example, cancer, malformations, weakened immune system and impaired reproductive ability.

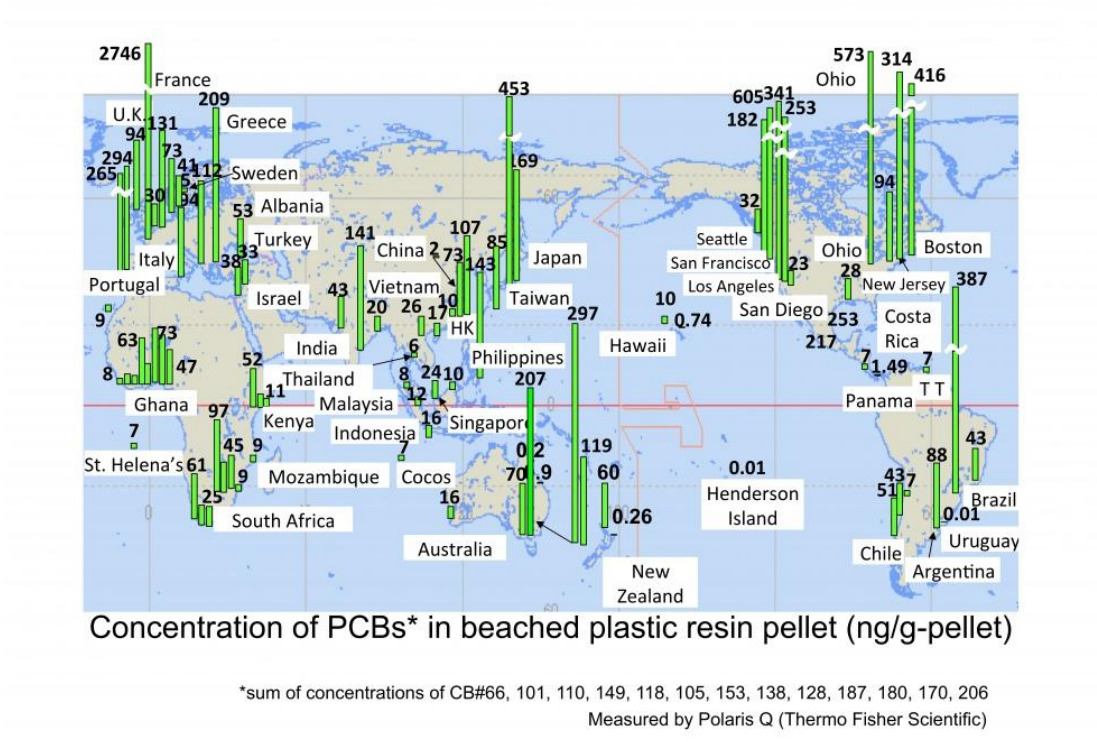


Figure 1.10: Distribution of the resin pellets sent to the IPW laboratory. Source: http://www.oceanhealthindex.org/News/Microplastics

The International Pellet Watch asks citizens around the world to sample resin pellets and send them by mail to the IPW laboratory in Tokyo, Japan. The latest available information refers to approximately 200 locations spread over 40 countries, providing evidence that pellets travel long distances as they have

been found on remote islands and also exhibit considerable levels of POPs concentration (see Figure 1.10).

It is already known that animals ingest plastic mistaken for food and then have the internal parts of their body obstructed, leading to severe injuries, abrasions or death. The effects of the introduction of hazardous chemicals into the animals' tissue is under research and has already revealed strong evidence of chemical transfer from microplastics (Thompson, Olsen & Mitchell, 2004; Moore, 2008).

1.2. Objectives of the study and hypothesis

One of the first impacts from scuba diving is the ability to move freely while underwater and enjoying the marvels of the underwater world, where everything moves and vibrates in order to feed and filter nutrients present in the water. Snell (as cited in Berkel, Albert Van Helden, 1999) described colours disappearing with depth and that beginners usually forget how to control their buoyancy; also objects are magnified 33% and 25% and appear closer to the eye. This is a result of refraction of the light when it travels through the water column into a new world which is about to be discovered.

Water is an alien environment for humans, and special equipment must be used for their safety, comfort and enjoyment. Experiencing the new environment, water, requires proper training with snorkelling or scuba gear in order to able to explore it. A mask with snorkel, fins and an exposure suit is recommended, and for safety a marker buoy should be carried to remain visible to boats passing in the area or to be seen from the shore. Avid snorkelers have the option to skin dive. This is where the diver descends with their breath held while keeping in mind to ascend before they run out of air. CO_2 builds up in the bottom of the lungs as a product of respiration, which means relaxation is required and good breathing techniques need to be employed. Free divers can train to descend to very large depths and compete for targets and records. It is "an activity involving physical exertion and skill in which an individual or team competes against another or others for entertainment" and has become a "sport" (Oxford, 2013).

Scuba diving, as mentioned above, requires more technical equipment, including an air tank, to remain submerged. This way divers remain underwater for longer periods exploring the alien environment. The diving-related activities mentioned earlier are crucial for observing marine ecosystems, and provide an opportunity to detect impacts from natural causes or anthropogenic activities. PADI (2011) nominated “divers and snorkelers the natural ambassadors for the aquatic environment” due to their active presence in the aquatic environment, exploring and observing short- and long-term impacts. Such activity enables a passive interaction with marine life and activates the senses, and the diver can learn from experience.

Marine debris is abundant across the planet and is growing worldwide. Investigating this issue is important in order to understand the sources, composition, distribution and potential effects of the debris (Keller, Fruh & Johnson, 2009). In 1975, the National Academy of Sciences recognized marine debris as any material produced, discarded or abandoned by humans, which reaches the oceans by any means. Usually it flows into the sea from streams or rivers, but it can also be carried by the wind from coastal areas or dumped from vessels.

From research findings, marine debris is defined as variable in type and has become a threat to the marine environment. According to Lee et al. (2006) and Hinojosa and Thiel (2009) marine debris is produced by fishing activities, ships, pleasure crafts, sea-based aquaculture activities and from land-based sources originated by population and industrial activities. Marine debris found in the oceans is diverse, with plastic the most persistent type due to its longevity in the ecosystem and tendency not to decompose (Calgani, Souplet & Cadiou, 1996).

Humans, having the knowledge about environmental problems are caused by anthropogenic activities, are still making the wrong decisions in regard their behaviour to minimize impacts (Tarrant & Cordel, 1997; Bamberg & Moser, 2007).

Borrie and Roggenbuck (2001) found that prolonged interaction with wildness tend to attach people to the environment; Vaske and Kobrin (2001) studied the relationship between place attachment and place identity with general environmental behaviours. Place identity mediates relations between place dependence and general self-reported pro-environment behaviour.

Moreover, Ajzen, Fishbein & Kraus (1988, 1975, and 1995) stated that behavioural intentions were proven to be indicators of future behaviour.

To target environmental behaviour (Smith-Sabasto & D'Costa, 1995; Stern, Dietz & Abel 1999; Vaske & Donnelly, 1999; Vaske & Kobrin, 2001), there are programs for environmental education for adults, which are largely under-researched and under-theorized (Dillon, as cited in Walter, 2009). "Learning grounds such museums, science centres, zoos, botanical gardens, visitor centres and nature activities are the most usual sites outside school" (Falk, 2005, p.2).

Cities are bustling with life and consumer-based economy is present in peoples' daily routine. The fact that divers and snorkelers have close contact with the water raises several questions regarding pro-environmental behaviour, which is part of the exploration for this study for adult education in natural environments, using the approach of scuba diving and environmental education.

Referring to the diving grounds where research has been conducted and where voluntary environmental education has been provided to tourists participating in a scuba diving activity, the study aims to contribute representative data for diving research and pro-environmental behaviour.

1. **The first objective to be achieved is to know if scuba divers respect the environment, and adopt attitudes that contribute positively to reducing their ecological footprint.**

2. **The second objective of this research is focused on the need to understand environmental practices in the divers' households, and what attitudes are taken in regard to reducing plastic and food waste**.

3. **The third objective is to reinforce the importance of considering scuba diving as a tool for sustainable tourism development.**

Environmental education in marine ecotourism was researched by Forestell (1993) who analysed whether visitors were being provided with enough information about the activity and surrounding environment. The author talked

about conservation taking place in the field in order to promote greater environmental awareness. Experiencing close proximity to wildlife, visitors start to question the animals' physiology and physiognomy, and safety distances in response to their emotions. Visitors tend to compare what they knew beforehand with what they have learned, and at this stage they are able to grasp the human impact on marine life and become more sensitive towards the environment.

Tourism experiences can have an effect on people when they return home. The fact that we have lives based on routine produces the need to go away on holiday and see different people, different places and do what we do not have time to do normally (Minnaert, 2012).

For studying the importance of scuba diving activity and how it might affect divers' behaviour regarding environmental practices, there is a need to know how much a diver can learn from a training course. Several questions arise, but it is important to remain focused on the potential that scuba diving training has, if there is only the interested in certifying more people, competing to be the most popular training agency or, if as well scuba diving carries the responsibility for educating participants about nature and how to reduce their ecological footprint.

Education and information will be seen as important assets for pro-environmental behaviour, thus the research will be able to answer the following hypothesis:

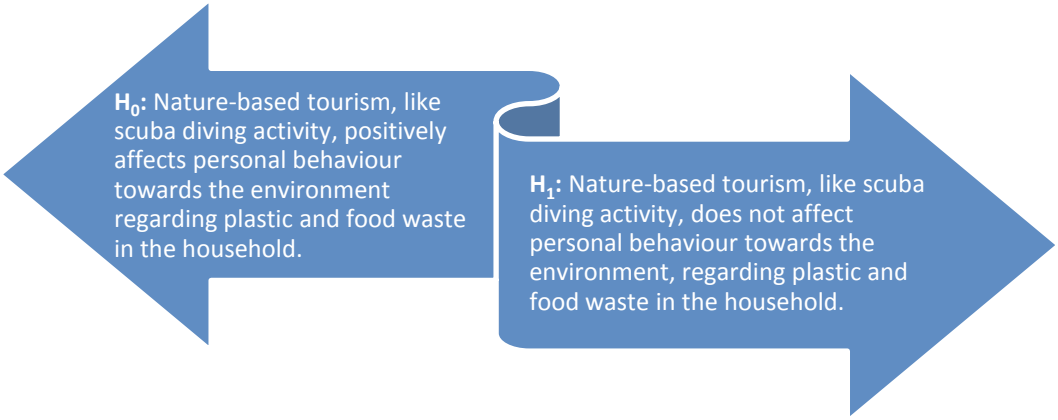


Figure 1.11: Hypothesis to be tested for divers' environmental behaviour change, regarding plastic and food waste in the household.

To testing the hypothesis the study used the “learning cycle” developed by Kolb and Fry (1975), which describes the experiential learning model and provides the opportunity for learning and behaviour change in any tourism form. As well the proposed model an adaptation of the Theory of Planed Behaviour (TPB) from Ajzen (1985) is used where “awareness” was introduced for testing long-term pro-environmental behaviour and to control divers’ attitudes on a pre-diving confrontation (see Figure 1.12).

From this experience, tourists traveling to a destination, who are motivated to go diving, start the learning cycle when engaging in a tangible diving experience, receiving detailed information and training. The tourists’ new concept of nature and how life really exists underwater will diverge from their previous suppositions through observation and reflection about the new concept. Information will be then assimilated forming new constructs, which can eventually be tested in real situations. The experience can be repeated or taken to the next level, having divers acquiring specific knowledge about the marine environment.

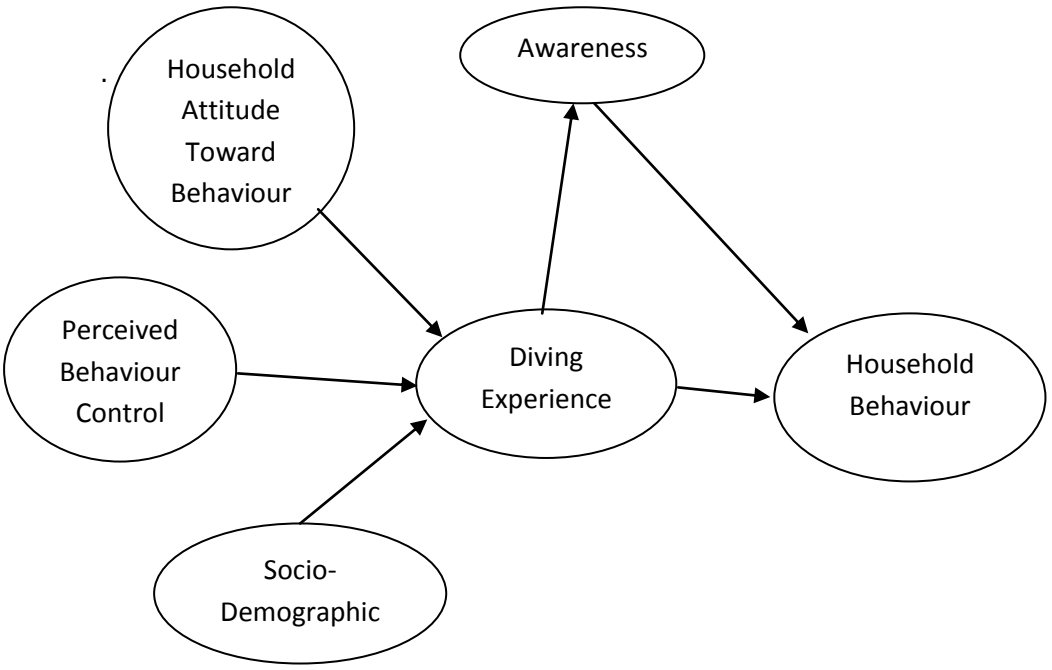


Figure 1.12: Model to study environmental behaviour change in the tourist’s household (Mota, 2013).

Chapter 1

The hypothesis was designed to answer two specific questions about environmental practices, and eventual behavioural change:

I. **Does scuba diving activity influence visitors' environmental behaviours in regards to plastic use and food waste in their household?**

II. **Do participants change their behaviour after being educated in scuba diving, or do they demonstrate a strong environmental conscience but continue with the same practices at home?**

Using the proposed model, participants report their "household attitude toward the behaviour" which is the state of the art for good environmental practices reflecting their level of involvement with the issue of preventing waste production, or factors to follow, or not, recommendations from local community for waste disposal. Participants gain environmental awareness through different life channels, which can be decisive for their behaviour or make them more sensitive to the environmental footprint issue.

Divers can be assessed for their beliefs or ability to perform certain environmental practices referred to as "perceived behaviour control". Such action can be perceived as difficult or simple to perform, but always carried out with conscience and control. Behaviour is measured through external conditions, which can affect decision making.

Demographic variables need to be taken into account to describe the population in the study. Profiles need to be drawn for the different levels of diver expertise and levels of education, age and income need to be considered. Indirect variables for measuring divers' profiles need to be addressed to the divers' geo-spatial residence and motivation for traveling.

Through diving experience, new subjects will be approached and awareness will be raised for the marine environment and of possible impacts caused by anthropogenic activities. Finally household behaviour will be measured by the amount of certain types of municipal solid waste produced, and behavioural change on a two-to-six-month long-term effect. Long-term impact and pro-environmental behaviours were studied with visitors to museums and

zoos seven to eleven months after their visit (Falk, Reinhard & Vernon, 2007), Ballantyne et al. (2010) studied wildlife tourism visitors with a focus on learning impacts and environmental sustainability, by assessing visitors four months after their experience.

1.2.1. Significance of the study

The discrete number of publications about scuba diving makes it difficult to measure the size of the entire diving community, and to predict the tendency line. Apparently scuba diving provides little interest for research regarding diver numbers (Garrod & Grőssling, 2008); only the WTO (2001) has published a market prediction for the first decade. Garrod and Grőssling (2008) reported that diving studies can mostly be found in journals and included in some edited books as a random chapter. The literature review uncovered detailed articles describing divers' profiles (see: Ditton & Baker, 1999; Cater & Cater, 2001; Mundet & Ribera, 2001; WTO, 2001; Musa, 2003; Contrel & Meisel, 2004; Grőssling et al., 2004; Todd, 2004; Musa et al., 2006; Belknap, 2008; Ong & Musa, 2011) and impacts on the local ecosystem and community, but attributing little importance to management issues (Garrod & Grőssling, 2008).

The work presented in this thesis is a contribution to the scientific community and aims to be an additional reference for profiling divers and their attitudes to reducing their ecological footprint and also an example for good natural resource management and environmental education. During fieldwork, a scientific paper was submitted for review, reporting environmental education for tourism providers and volunteers in marine protected areas. The study case of the Cozumel Reef National Park in Mexico revealed how the environmental education course could be used as a tool for resource management, referring to detailed information about diving-related professionals operating inside the park, and is an example of a local agenda for achieving environmental indicators, identified for the sustainability of the island.

The studies by Hawkins and Robert (1992), Davis et al.(1995), Rouphael and Inglis (1997), and Santander and Propin (2009), were centred more on describing how divers impact the reefs by not following good diving practices

and when demonstrating a lack of environmental awareness. Predictors for underwater behaviour and comfort were also reported and analysed by Ong and Musa (2011), and Musa and Dimmock (2012).

The learning cycle provided by Kolb and Fry (1975) authenticated the tendency for expected experiential learning, having participants engage in a real experience and receiving new inputs for underwater behaviour. The experience of observing eventual marine debris bounded with previous environmental education guidance increases awareness among participants, sustaining further responsibility for behavioural change in the divers' daily lives.

The present research claims originality by studying divers' behaviours in their household, reporting data about environmental practices regarding plastic and food discards. Based on the diving education experience and observations of marine debris in the Cozumel Reef National Park, the study aims at better resource management by educating tourists in environmental awareness.

1.2.2. Limitations of the study

Perhaps the biggest limitation can be assigned to divers, who have their diving excursions with the dive operators involved in the research. In the field, operations are run in a customer-orientated manner according to their length of stay on Cozumel Island and nationality. Divers from the U.S. were sampled for quantitative research, and divers of other nationalities were also welcome to participate and thus provide qualitative analysis for foreign nationalities visiting the island. Divers arrive at Cozumel Island mainly by cruise ship and stay for only 7 to 11 hours. The daily passenger ferry boat crossing from Playa del Carmen can also be used and there is the option to fly in to Cozumel International Airport.

The daily turnover of tourists puts pressure on logistics with the multitude of pick-up shuttles for hotels, cruise and ferryboat terminals, and diving schools. Services running from early in the morning places the rush hour between 7:45 am and 9 am. The diving operators involved in the research had customer service as their main priority, which meant they sometimes neglected the survey phase for random divers and also the survey for diving students. There was a

need to schedule visits to diving operations and to install several drop boxes where customers could fill out the survey and afterwards leave it behind the same box. When signing up for diving and introduced to the researcher, customers usually showed interest in volunteering for the study, but the majority of divers were short on time to get to the harbour or to the boat. Divers were always respected if they refused to fill out the survey due to a lack of interest or time.

The surveys were always taken nearly in the morning in town and at the dive base facility, and having only one spot used for research being distant 17 km.

On the Caribbean Sea, Cozumel Island is one of the major ports of call for cruise lines, supporting the research target for majority of the with origin in the U.S. During “spring break”, thousands of teenagers visited the island and some participated in the study. In order to avoid bias, sampling could not include all vessels, so participants were selected for the study on random days.

Another limitation was the time spent on the island. The tourists traveling by cruise ship went scuba diving early in the morning and needed to be back on boardin7 to 11 hours. For participants completing a diving course or participating in a scuba diving discovery experience, it was very difficult to register their attitude for consumption of plastic or food related items on Cozumel. Furthermore, they did not have the need to purchase any items due to the fact they had an all-inclusive travel package. It is important fact to take this fact into account as it means they did not spend money in the local community, and especially because the study is meant to increase awareness for customer-based consumption and dependence on plastic or food-related items.

The research was designed to survey only behaviours relating to plastic and food discards, excluding other pro-environmental practices in the household. In some cases, participants mentioned local regulations for solid waste management and expressed interest in research on other environmental issues.

1.3. Methodology

Having experienced scuba diving and thought several hundred of new divers, was the reason to write this research methodology, investigating what students actually learn from a scuba diving course. The discussion led to an understanding of the benefits of environmental education courses linked to human behaviour and for reducing divers' ecological footprint. The study looks for a possible relationship between scuba diving activity and pro-environmental practices in the household, with the hope that perhaps marine debris can be reduced and plastic used in a more sustainable and reasonable way.

Long-term learning impacts (Falk, 2007; Ballantyne, 2010) have the need to be measured in order to understand divers' behaviour in their home, and likewise at the destination. Having knowledge about the facts and impacts from human behaviour, information can be used to manage resources and invest in sustainability for tourism destinations. Responsibility is credited to tourists who make the choice to purchase their holiday and who should always be provided with enough information about possible impacts and benefits. Nevertheless, tourism receptors share their responsibility, and should develop more programs for educating tourists and tourism providers, and guarantee a good management of resources.

Marine protected areas (MPA) are more attractive for divers and provide a large number of dive sites (Davis & Tisdell, 1996). Nature-based tourism in Australia can be compared to small business operations where there is the need for good marketing strategies due to business competition. Dimmock (as cited in Jennings, 2007, p.135) referred to business success as being achieved when companies carry the responsibility for preserving a natural site. Success is highly related to "quality of diver experience with the site as well as factors related to the service, information, and equipment".

In certain coastal areas, communities strongly depend on tourism (Musa & Howard, 2003; 1999) and offer products matching visitors lifestyles (Leiper, 2003), or extravaganza attitude, breaking environmental rules, or interfering on cultural and social organization.

For the research project scuba diving was chosen as the nature-based activity in order to study possible behaviours in relation to the environment. A literature review of the Millennium Development Goals (MDGs) of the United

Nations Development Program (UNDP),revealed that goal 7was to “ensure environmental sustainability” and that seven new critical issues had been placed on the 2015 development agenda for Rio+20: jobs, energy, cities, food, water, oceans and disasters. The United Nations Decade of Education for Sustainable Development (2005-2014), launched on March 1st 2005 in New York, led to the environmental indicator for municipal solid waste generation, according to the Organisation for Economic Co-operation and Development (OECD) Fact Book. The country producing the most municipal solid waste is the United States of America, with more than 720 kg per capita in 2010, according to the latest available annual data (OECD, 2013, p. 175).

Having found the population target for the study, there was a need to set crucial points for investigation, outlining possible issues where divers could be assessed for attitudes and pro-environmental behaviour. The Environmental Protection Agency (EPA) reported that 250 million tons of municipal solid waste are generated in the USA per year, before recycling, counting “food waste the largest material in discards at 21.3%, and plastic the next largest as 17.8%” (EPA, 2013, p.5).

As mentioned above marine debris can originate from pleasure craft, sea-based aquaculture activities, and land-based sources produced by the population (Lee, Cho & Jeong, 2006). Scuba diving is an activity that allows participants to be submersed in water and observe marine life and any debris that has been carried by the current or is just lying on the reef. The connection between scuba diving, debris, and plastic and food-related discards is pointed out during the “environmental education talk” given by the diving instructor, and in the open-water training while visiting the reefs. Knowing about how fragile the marine ecosystem is, and how anthropogenic activities can affect sea creatures, divers can learn to respect the environment and adopt pro-environmental behaviour at home.

For assessing divers regarding the variables in the study and testing the hypothesis mentioned in section 1.2, a measurement tool was developed for the three-phase survey. Research questions used in the study reflect the contribution by international authors and can be found in their publications (Kaiser, Doka & Hofstetter, 2003; Bortoleto, Kurisu & Hanaki, 2012; Rodríguez-Barreiro, Fernández-Manzanal & Serra, 2012; Miao & Wei, 2013). All data collected were transferred to a database designed for statistical analysis

software used for two-step cluster analysis. The first survey was administered to all diving participants, and the second only to participants in diving courses; both provided quantitative data for the research. The third format, designed to collect qualitative data and register long-term learning impact through behavioural change, was administered online to all divers and students, who agreed to participate in the last phase of the study.

1.4 Summary and discussion of Chapter 1

Since ancient times, humans have lived off the water environment, risking their lives to obtain food for survival and to provide economic activity for society. With Jacques Costeau and Emile Gangan's re-invention of the breathing regulator to include a demand valve in 1943, a new world was opened up for discovery, and many expeditions have been made since to explore the sea bed. Scuba diving allowed men and women to learn more about the oceans and it later became a leisure activity. It has continued to flourish and gain relevance among people devoted to the sea.

The WTO (2001) had the prevision to strongly expand the growth of the activity until 2010, which saw diving take place in remote and unexplored locations and the result that scuba diving became a trendy activity. Tours operators started showing interest in getting involved, proposing associations with specialist diving bases. Due to a better and more expansive flight network, local managers were able to strike up partnerships with dominant and larger operators. Diving destinations have developed to a point where the whole family can travel to them, with tourism products and attractions now generated for pure entertainment. Single diving is a target for growth likewise diving couples, pre-marriage and pre-family divers.

The popularity of diving-related activities has mostly been seen in snorkelling and scuba diving activities (Orams, 1999). The economic factor plays an important role as diving equipment tends to require a bigger economic outlay, whereas snorkelling requires far less equipment, fitting better for traveling.

As the leader in the diving industry, PADI (2013a) has certified over 750,000 new divers every year for the last 16 years. The training agency has

reached such a level of standardization that is represented in more than 180 countries, offering diving courses in more than 26 languages.

Environmental impacts were noted in terms of providing positive aspects, mainly represented by economic benefits and employment opportunities. The negative side was revealed by wildlife impacts whereby animals have changed their behaviour due to contact with tourists, with authors reporting their concerns and measuring the consequences and long-term learning impacts (Forestell & Kaufman, 1990; Orams, 1996; Falk et al., 2007; Ballantyne, et al., 2010). The over-usage of the reefs has resulted in physical devastation and chemical contamination. Land development in support of scuba diving has also caused negative impacts and affected the surrounding infrastructure, with alternating living patterns and by creating economic differences among the local society (Rouphael and Inglis, 1997; Moscardo et al., 2001; Musa, 2003; Garrod & Grőssling, 2008).

Marine debris originating out at sea is mostly related to activities related to the fishing industry, fish farming grounds and other offshore installations. Debris can also come from land, which has reached the sea from surface runoff, streams, rivers and lakes (Hinojosa & Thiel, 2009). Impacts are created from marine debris, which have a strong effect on the marine ecosystem, and also beaching aesthetic debris on the shoreline (Coe, 1990; Calgani et al., 1996; Martins & Sobral, 2011; WSPA, 2012).

Animals can become entangled in marine litter, preventing them from swimming, feeding and reproducing (WSPA, 2012). Debris has been tracked along the major shipping routes and can travel large distances. Hinojosa and Thiel (2009) cited the main negative impacts of marine debris on animals as entanglement, ingestion and transport of associated fauna. Those are certainly the major reported impacts as animals often get entangled in fishing gear and cables traveling in the water. Also debris can be mistaken for food as be ingested, or carried away for feeding to young. Debris drifting on the water can offer an opportunity for some species to hide from large predators or even travel to territories where they are not native.

The recognition of a worldwide environmental problem has driven legislation for protecting the seas and the ecosystem. The Marpol 73/78 international convention has forbidden the dumping of waste, oil and exhaust pollution from ships, which has minimized pollution at sea. However, this is still

not enough to control marine debris. For instance, Styrofoam can still be found floating in abundance in water environments, having originated mostly from fish farming facilities, bottles, plastic bags, and other types of debris (Hinojosa & Thiel, 2009). Countries have become interested in the issue and are monitoring their shorelines and registering the findings. Ivar do Sul and Costa (2007), and Martins and Sobral (2011) found small debris stranded on beaches containing persistent organic pollutants (POPs).

The great Pacific Garbage Patch was estimated to be the biggest in the world, where debris has accumulated due to the movements of the Earth and thermohalines mixing currents with different salinity and temperature levels. This important fact has driven the international community to discuss possible options to minimize the problem, and to sign the Declaration of the Global Association for Solutions on Marine Litter. Six main projects have been developed for educating the population, conducting more research, working on public policies, sharing best practices, working on plastic recycling and recovery programs, and for controlling the "plastic lifecycle process".

Once the problem was identified, further research was taken to new levels of discussion; microplastics have become an important issue–they are so small that in some parts of the world they can be found near the oceanic Gyres, industrial facilities and commercial harbours (e.g., Noren & Naustrall, 2010; Goldstein et al., 2012). Microplastics have started to be found inside animals (Boerger et al., 2010; Browne et al., 2011; Goldstein et al., 2012; Lusher et al., 2012; Choy & Drazen, 2013; Wright et al., 2013), causing physical impairments and in some cases clogging their system leading to death.

Another important issue is the legal standards for incorporating plastic in cosmetics. Gregory (1996) called attention to the impact of micro-beads in hand cleansers, and today they have taken over from most of natural exfoliates. Studies conducted at the Great Lakes revealed that 400 times more micro-beads were sieved from samples taken from two nautical miles of water than in all the oceans where the institute had collected samples from previously. To get an idea of the scale of the problem, a single 128 ml tube of deep clean scrub can contain up to 350,000 micro-beads, which get flushed way into the drainage system.

The international community is on alert, and based on current research some environmental organizations are pushing governments to work on effective legislation to ban such products from the market.

Microplastics are also being monitored around the world. Takada (2005) set up the International Watch, which asks for volunteers from all over the world to send in samples of resin pellets stranded on local coastal areas. Back in the laboratory, the pellets ranging from 1 to 5 mm in size are analysed for POPs and possible linkage to the food web. Thompson et al. (2004) and Moore (2008) associated the adsorption of POPs with chemical transfers into the body structure of animals.

The present research tests the hypothesis of using the synergy between scuba diving and the natural environment to determine if environmental education sessions can be used to shift divers' behaviour towards better waste management practices in the household. As the main composition of marine debris is plastic, divers will be assessed in regard to how they discard plastic and food, with the aim of helping to reduce marine debris.

Through experiential learning the whole diving community can become more alert to arising problems as a result of the misuse of natural resources. Environmental education programs were developed for educating both tourists and the local community, with locals acting as guardians of the natural resource and playing an important role in the conservation of marine species.

Chapter 2

2.1. Literature review

Aiming for an updated literature review, this chapter describes the general foundation for conducting research on marine debris, and some of the instruments available for dealing with the issue. The approach to current environmental issues and learning theories are compulsory in this thesis, providing a basis for a better understanding of behaviours toward the environment, in particular in households in the United States (U.S.). Governments and Non-Governmental Agencies are trying hard to work together to minimize the impacts on the environment, but it is also our responsibility as citizens to take care of our own actions.

Current practices for waste management have been demonstrated to be inefficient or poorly managed, and as a result marine debris is floating in the sea causing animals to become entangled, which prevents them from feeding, swimming and reproducing. Marine debris has been demonstrated as being harmful to marine life (Hinojosa & Thiel, 2009) and also causing damage to manmade structures (WSPA, 2012). Animals eat debris mistaking it for food; plastic is bioaccumulative and the ingestion of marine debris has been proven to cause a slow death, which is both cruel and unfair, afterwards we are also animals.

Today multidisciplinary research is required for approaching the current problems mostly derived from anthropogenic activities on land and at sea. Different subjects are blended together in this research work, which covers international commitments made since the creation of Agenda 21 for sustainable development, and joint programs from the World Tourism Organization, which provide important data about tourism and its importance for the economy. Tourism has become much more accessible and every day new destinations are promoted, but responsibility comes with this for both the host and traveller.

Tourism is the fourth largest export sector in the world, and is responsible for 1 in 11 jobs (UNWTO, 2013). It is an interdisciplinary activity where different skills and professions are required to sustain it. Tourism also generates waste as local economies grow, more advertising campaigns are seen on the street,

import/export demands increase for feeding tourists, more recreational activities are created, etc. – all generating waste. For example, the chapter written in partnership with the WTO for describing investments in “greening” tourism activity, compares solid waste production derived from tourism activity at several geographic positions across the globe. In Austria 1.18 kg of solid waste is generated per person per day, while in the USA the figure is approximately 2.3 kg, and in Mexico and India 0.68 and 0.4 kg, respectively (UNEP-UNWTO, 2012).

For studying divers’ behaviour in regard to good practices for waste management in the household, it is important to understand the possible differences in learning methods chosen by tourists. For example, non-certified divers can enrol on a dive training course with a standard set up for theory lessons and practicing in-water skills, while intro programs or one-day diving excursions benefit from flexible approaches for making the experience safe and enjoyable. Thus, according to the PADI standard rules for safety and good practice, and only when accompanied with a diving instructor, participants can engage directly in diving activity with the minimum of knowledge. Further engagement in training sessions requires achieving theoretical, and practical performance requirements by students motivated for learn about diving theory.

Regarding the proposed model, the use of the theory of planned behaviour (Ajzen, 1991) provides fields for registering the participants’ observations. The assessment focuses on their household behaviour and perception of marine debris found at the tourism destination. Scuba diving becomes the vehicle for studying long-term impacts by enhancing the divers’ consciousness of the issue while attending informal environmental education sessions, and seeing with their own eyes marine debris at the dive site.

Through a responsive reaction, the study aims to evaluate how much divers learn from their experience and determine if there is any long-term behavioural change to environmental practices regarding plastic and food discards. The research process uses the environmental education indicator for Cozumel Island, imparting knowledge about the local marine environment and good diving practices.

2.1.1. Millennium Development Goals

In 1972, the Stockholm Earth Summit on the Human Environment presented a list of 26 principles and 109 recommendations from which international laws evolved. The United Nations Conference on Environment and Development held in Rio in 1992 was intended to make governments rethink their economic development policies and find ways to curb pollution and the destruction of natural resources by introducing concepts of sustainable development highlighted in the Brundtland report, “Our Common Future” (UN, 1987), which later become the 40 chapters of Agenda 21 and the 27 principles of the Rio Declaration on Environment and Development. It defined sustainable development as development which *“meets the needs of present generations without compromising the ability of future generations to meet their own needs”* (Gardiner, 2002, p.1).

A revision of the implementation of Agenda 21 and recommendations for further achievements took place in 1997 during the Earth Summit +5 in New York. During the Millennium Summit in September 2000, world leaders established new goals and objectives for the millennium, presenting indicators for sustainable tourism (Frausto & Chale, 2003). A new vision for the future was presented through a set of eight Millennium Development Goals (MDGs), providing targets to be met during the period 2000 – 2015:

“A world with less poverty, hunger and disease, greater survival prospects for mothers and their infants, better educated children, equal opportunities for women, and a healthier environment; a world in which developed and developing countries worked in partnership for the betterment of all“ (MDGs, 2000).

World leaders from 147 countries committed themselves to focus on the poor and, based on respecting human rights, achieving progress through sustainable economic growth. The seventh MDG, “Ensure environmental sustainability”, set important targets to be achieved through a set of related indicators (see Table 2.1).

Table 2.1: The four targets for achieving the 7th Millennium Development Goal "Ensure environmental sustainability".

Target 1:	"Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources."
Target 2:	"Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss".
Target 3	"Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation".
Target 4:	"By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers".

Source: MDGs, 2012.

The environmental goal targets important issues affecting humanity and the whole ecosystem on the planet. The "green area" is an important substratum for life, converting light into chemical energy as fuel for organisms, using CO_2 for their life cycles, and releasing O_2 as a product to the atmosphere. Sustainable life is strongly affected by the deforestation rate.

New forests have been established and regulations have become tight enough so that "over the last 20 years deforestation has been decreasing from -8.3 million hectares per year in the 1990s to -5.2 million hectares per year in the last decade" (MDGs, 2012, p.46).

South America, Africa and Oceania have been vigorously affected by constant fires in Australia, deforestation in Borneo and severe drought at drier latitudes, but programs to reforest certain areas in China, India and Vietnam have been in place in the last decade.

The loss of environmental resources can have many causes – when related to sustainable development it tends to be from the use of materials for the development of societies which generate impacts from CO_2 emissions. The comparison of emissions from carbon dioxide (CO_2) in 1990, 2009 and 2010 in billions of metric tonnes (bmt), is presented in 3 main charts, picturing the overall emissions in developed regions, developing regions and the world (see Figure 2.1).

Regions are differentiated by 57 developed countries, which together caused 13.7 bmt of CO_2, but are making efforts to reduce emissions by investing in technology and renewing policies. According to the Population Reference Bureau (2012) over 1.2 billion people are living in such regions. Comparatively, over 5.8 billion people living in a larger area of 161 developing countries generated 18 bmt of CO_2 (Millennium& Goals, 2013).

From more than 7 billion people living on the planet, 17.6% live in more developed countries and 82.4% in less developed countries (PRB, 2013).

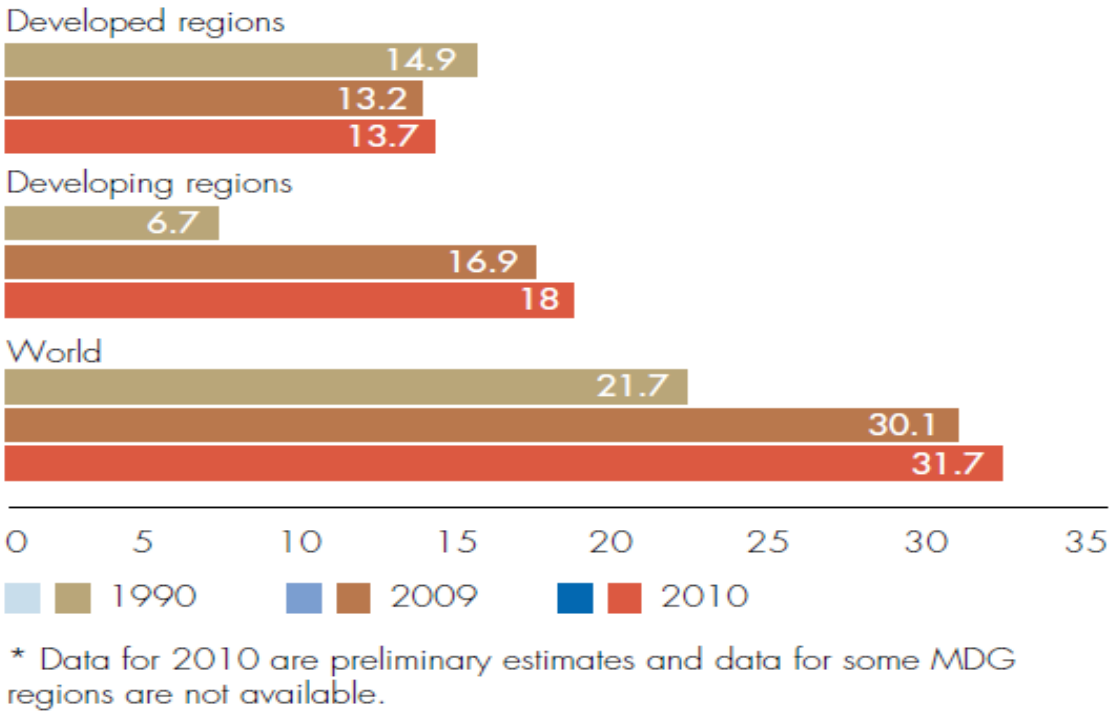


Figure 2.1: Comparison of carbon dioxide emissions (CO_2), 1990, 2009 and 2010, in billions of metric tonnes (Millennium & Goals, 2013, p. 43)

The reduction of 8.7% (14.9 – 13.7) of CO_2 emissions since 1990, and an increase of almost 4% (13.2 – 13.7) in a 1-year period (2009 – 2010) in developed countries can be attributed the development of technology in those societies where environmental legislation has become more strict; nevertheless industry has been displaced to developing countries in the last decade where emissions have grown by 168.7% (6.7 – 18) since 1990, of total CO_2 emissions growing by 6.5% (16.9 – 18) during the same 1-year period.

A fact to consider when new opportunities for progress were created in developing countries is that perhaps total CO_2emissions increased by only 6.5% due to the economic crisis affecting international markets, updated technology transfer to factories established in developing countries or simply from following the protocols to achieve MDGs. Overall consumption of goods decreased compared to previous years, less consumption struggle the need to purchase and sell exceeding stock, and also companies became more cautions due to a fluctuating economy and market demand.

The 2011 United Nations Climate Change Conference in Durban saw the launch of “another initiative to build one legal instrument for stronger actions on controlling climate change” (MDGs, 2012, p.48), which was expected to be implemented in 2020. Nations have the need to reduce the gap between the already agreed emissions-reduction targets and what in reality is being accomplished. Emissions per capita are always higher in developed countries, which for instance generated over 11 metric tons of CO_2 per person in 2010 compared to 3 metric tons in the developing world.

Once the economy recovers, developed countries will produce even more CO_2 gas than in 2010, which is a fact to consider when looking at how to reduce the gap.

Since 1990, protected areas have been considered for protection and conservation of natural habitat, doubling terrestrial protection in 59 of the 228 listed countries and dependencies on database. Marine protection represents higher numbers, with 86 registered areas in 172 countries. The number of marine protected areas have risen in importance up to 12 miles offshore where the line for international waters it set. It “has increased from 3.1% in 1980 to 7.2% in 2010... it is known that protected areas are strongly related with reducing declines of species, although half of the world’s most important terrestrial sites for species conservation remain unprotected” (MDGs, 2012, p. 49).

The number of important protected sites has increased since 1950, but the total protected area for biodiversity sites has declined overall.

The International Union for Conservation of Nature’s (IUCN) Red List Index (RLI) stated that species of mammals, birds and amphibians would have declined more had it not been for conservation actions. 39 bird species were one step away from extinction during the period from1988 to 2008; 29 mammals

were also very close to extinction, and the protection of species has had a positive effect during the period 1996 – 2008.

Fish stocks are continually being depleted like never before. In 1974 about 10% of fish stocks was declared biologically unsustainable by catch, requiring strict actions to recover productivity. Following an increase in demand, fish stocks have fallen to dangerous levels of overexploitation, ascending to 32% in 2008, and one year later “395 monitored fish stocks were accounting for 70% of the global catch, 30% were overexploited” (MDGs, 2012, p. 51).

The world’s population is constantly increasing (see Figure 2.2), demanding more resources and struggling for places to live. Up until 2010, and over the previous 20 years, accessibility to improved drinking water increased from 76% to 89% of the world’s population.

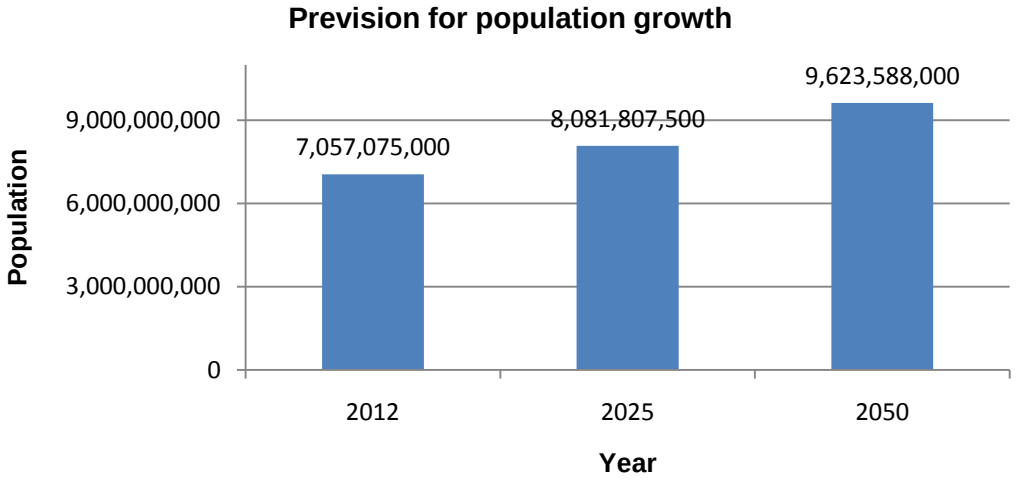


Figure 2.2: Estimative for population growth. Source: PRB 2012.

The United Nations (UN) has set a time limit for providing safe drinking water to the population. The target set for 2015 was reached 5 years ahead of time, representing efforts by people and nations in cooperation. By 2015 it is now expected that 92% of the world’s population will have access to safe drinking water.

During the period 1990 – 2010 access to basic sanitation increased from 36% to 56% in developing areas, although it is estimated that half the population

living on these areas is still deprived of sanitation facilities. According to the Population Bureau 77% of the population living in rural areas have usage of an improved water supply, compared to urban areas where 96% of the population can access an improved water supply. Regarding the world accessibility to sanitation, 45% of the population living in rural areas, and 76% of the population in urban areas benefit from improved sanitation.

Populations deprived of such conditions are usually residents in slums or very poor areas, and accentuated more in developing countries. The tendency is decreasing: Over a ten-year period (2002 – 2012) the proportion of people living in slums dropped from 39% to 33%. Improved sanitation and water supply have been provided to more than 200 million people, and living facilities have become less crowded and more.

Most areas show a decrease, but around the world the number of slum dwellers continues to grow due to the high pace of urbanization (MDGs, 2012; 2013).

During the UN conference in September 2000 international development objectives were set under the banner of “The Millennium Development Goals”, which were ratified unanimously by 147 world leaders, and targeted to be reached by 2015. General thoughts were addressed to what will come next and after 2015. Manning (2009) outlined a possible timetable for the discussion of possible approaches, goals and target indicators for the new goals, the MDGs 2.0. Through international summits, goals have been assessed and discussed, leading some authors to think that targets could be more realistic and appropriate:

- “...Goals overlap for global education and education equity”,
- “...There is no binding on industrialized countries”,
- “...Goals should define human development outcomes or opportunities to achieve”.

Source: Adapted from Karver, Kenny, & Sumner, 2012.

Already concerned with the future of the MDGs, organised groups are collecting opinions and working on proposals to legitimize a new framework focusing on essential must-haves. The “Beyond 2015” movement gathered

some contributions from workshops at the 2011 World Social Forum, from NGO's, scholars, and research conducted by Southern partners about what goals need to be met (Leadership, Legitimacy, Substance and Accountability).

The MDGs have certainly reached some targets, but remain distant from the initial intentions. In order to set new goals for post 2015, groups of experts are analysing the previous MDGs, agreed on at the 2000 Millennium Summit, and evaluating the impacts of such goals in order to define an updated strategy for the new framework. This offers an opportunity to correct past problems by proposing new targets for the coming period. The accomplished development success flags certain critics in regards to ecological footprint, the MDG # 7, to "ensure environmental sustainability" still vague, not presenting an absolute guideline on his generic assembly.

Based on previous MDGs, Colombia and Guatemala have proposed a new set of "Sustainable Development Goals" (SDGs) included on the new agenda for 2015.

Despite all efforts and the board of experts under international leadership, there is antagonism from the "Group of 77 which would not accept another UN- or expert-led process of the kind that established the MDGs" (Beisheim, 2012, p.2). The group claims their capacity for delivery and promotion of their economic interests, appreciating joint capacity on all important economic issues in southern hemisphere countries within the UN system. South-to-South cooperation brings more benefit to developing countries, allowing development without dependency and rule from the North. Consequently, there is an "Open Working Group" (OWG) working on setting new SDGs agreed upon by a member state group, comprised of30 members from UN's regional groups.

There are key questions regarding the setting of a new timeframe for continuing with MDGs, such as whether targets are really effective or should changes be made. Manning (2010, p.11) also questioned whether a problem solution is only about sustainability or pro-poor development progress, or if medium-term measures should be collectively adopted.

Guidelines containing targets and indicators to measure sustainability are on the table and part of the local agenda, although critics are arguing that the tool can be used for adjusted local sensibility. Not only does commitment to addressing issues and problem solving require financial exercise to support

solutions, but also capable human resources that make use of the MDGs to achieve a more sustainable development.

2.1.2. UN sustainable tourism program

The first steps made by the United Nations World Tourism Organization (UNWTO) towards creating a sustainable tourism program date back to1925 when the International Congress of Official Tourist Traffic Associations (ICOTT) was formed at The Hague (Netherlands), and later in 1934 with the creation of the International Union of Official Tourist Propaganda Organizations (IUOTPO). The decision to set up a non-governmental organization, redeeming the IUOTPO was approved during the First International Congress of National Tourism Bodies (ICNTB) in 1946, and the First Constitutive Assembly of the International Union of Official Travel Organizations (IUOTO) took place in 1947, and was recognized by the United Nations a year later.

The new organization focused on international travel connections has urged the United Nations to take action, declaring 1967 the International Year of Tourism under the slogan “Tourism, Passport to Peace”, and adopted the statutes of the World Tourism Organization (WTO) in 1970. 27th of September was declared World Tourism day, which has become an important date for emphasizing the importance of tourism in promoting cultural, political, social and economic ideals.

The First WTO General Assembly, hosted in Madrid (Spain) in 1975, gathered together 156 countries, 6 associate members and over 400 affiliate members from the private sector, educational institutions, tourism associations and local tourism authorities. In the following years the WTO became an executing agency of the United Nations Development Program (UNDP), carrying out technical co -operation with governments. The WTO contributed to the elaboration of Agenda 21 during the Conference on Environment and Development in 1992, and took part in the World Summit on Sustainable Development in Johannesburg (South Africa) where the programme for Sustainable Tourism – Eliminating Poverty (ST-EP) was presented, comprising part of the final Summit declaration (UNWTO-web, 2013).

A list of events and conferences dates back to the beginning of the organization, which through the promotion of sustainable tourism have contributed to achieving the MDGs. Programs are presented during international events or emergency meetings for crisis management and catastrophes, drawing up measures to assist people and territories affected by natural causes, which can benefit from tourism action plans. One example is the Phuket Action Plan, adopted in 2005 following to the destruction caused by the tsunami in South East Asia in December 2004. Substantial financial assistance was moved to the region in order to support (Report, Methodology, W. T. O., & Indicators, S. T., 2005):

- *Marketing communication*, informing the international community about the importance of generating income in such regions, regaining confidence in the market place.
- *Community relief* in providing technical and financial assistance to small and medium-sized enterprises. Many businesses were family dependent and lost family members.
- *Professional training* for thousands of people affected by the tsunami. Affected areas have since experienced a high rate of unemployment. The plan of action gave the opportunity for young people and women to be retrained for new jobs.
- *Sustainable Redevelopment* in correcting past issues, and through social involvement in the planning process the re-emerging destination can become the leader in environmental conservation.
- *Risk Management* being conducted along coastal areas and actions taken for beachfront constructions. Training was provided in alert systems, and communication was improved between the tourism sector and public authorities.

Programs for sustainable development adhere to the Global Code of Ethics and aim at “developing tourism with a view to contribute to economic development, international understanding, peace, prosperity and universal respect for, and observance of, human rights and fundamental freedoms for all without distinction as to race, sex, language or religion, … in keeping with the

rationale of reconciling environmental protection, economic development and the fight against poverty in a sustainable manner, as formulated by the United Nations in 1992 at the Earth Summit of Rio de Janeiro, and expressed in Agenda 21" (Nations, 1999, p.1)

The WTO promotes and monitors tourism for economic growth of populations, regions and nations, and promotes sustainable tourism as a form of inclusive development through offering development programs and experts for implementation of tourism policies worldwide. Programs encouraged by the WTO aim to amplify socio-economic progress while attenuating its possible negative impacts.

Inserting tourism activity into the global agenda is the strategy adopted by the WTO, using the value for socio-economic growth and tourism development, carrying responsibility for the sector in being included in national and international policies. Sustainable tourism development supports policies and practices in balance with natural resources by respecting the socio-cultural community and always providing benefits for all. By making tourism part of the global agenda poverty can be reduced through achieving MDGs. Education processes can be addressed in order to solve local development needs, train personnel and provide network exchange and knowledge development. Partnerships play an important role where participants benefit from knowledge transfer and involvement in tourism development programs, which enhance competitiveness.

"Technical Cooperation and Service Programs are carried out in over 100 countries and are the link between the UNWTO and its 155 Member States" (UNWTO, 2011, p.2); their statistical reports on the tourism industry are reliable documents for planning strategies and predicting world tourism positions. The UNWTO Tourism Highlights (2013, p.2) are listed as the following:

- Tourism directly, indirectly and inductively represents 9% of global GDP.
- Tourism is responsible for one in every eleven jobs worldwide.
- Tourism is the fourth largest export sector in the world after fuel, chemicals and automotive products, generating over $ 1.3 trillion a year.
- Tourism represents 6% of the world's exports.

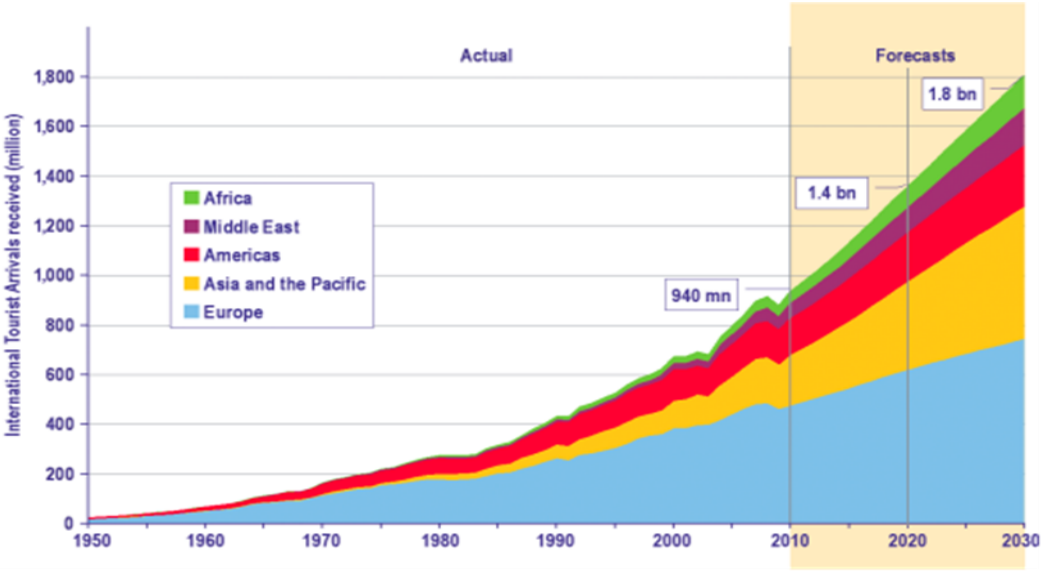


Figure 2.3: International tourist arrivals forecast for 2020 and 2030 (UNWTO Tourism Highlights, 2013).

Tourism has developed and become very competitive in relation to other economic sectors and is becoming one of the largest. See Figure 2.3 and the 2012 key trends presented below (UNWTO Tourism Highlights, 2013, p.3):

- For the first time, international tourism arrivals exceeded 1 billion in 2012, showing a tendency to continue growing.
- Europe was the most visited region in the world, and the persisting conflicts in the Middle East has not yet succeeded in returning to growth.
- Asia and the Pacific Region registered the strongest growth (7%), followed by Africa (6%) and the Americas (5%).
- Worldwide, the WTO estimated $1,075 billion for 2012, and new records have been set that are approximately 3% more the previous year.
- The UNWTO forecast tourism to grow by 3% to 4% in tourism arrivals in 2013, and Asia will be the strongest region, followed by the Pacific and Africa.

Data from 1980 reveal 277 million international arrivals, making it the fast-growing activity in 2012, when for the first time there were over 1 billion tourists. Tourism induces economic growth and is responsible for 3.4 billion daily

exports. Goods need to be exported to support tourism activity at modern tourist destinations and development. These exports account for 6% of global trade exports and 30% of commercial services (UNWTO Tourism Highlights, 2013).

Exportation of goods can bring along important impacts that need to be measured such as CO_2 emissions, energy demand and local environmental degradation can be addressed to development, but as well used to educate tourists. Tourism destinations can struggle with discards if technology and facilities are not available; furthermore, visitors and the local population must be aware of and participate in environmental education programs.

2.1.3. Education and tourism

Access to empirical data about educational tourism is still scarce, perhaps due to the lack of interest shown by the tourism industry (Ritchie, 2003). Definitions for tourism have been developed according to the needs of authors, and can vary from the consumer's to industry's point of view. Education comprises several forms of learning and takes place traditionally in schools, or involves work-based education programs. Learning takes place through casual actions, occurring at any time or place, and is associated with the process of gaining knowledge or experience.

A corresponding situation was established for education tourism where participants undergo a learning process, acquiring concepts and extending knowledge. Empirical contents were studied for further practical application; for example, visitors to the Mayan ruins in Mexico might be interested in studying Mayan culture and rituals, and traveling to visit the ancient ruins in order to witness first-hand what they had studied. In some cases, obtaining professional guidance during a visit enhances the level of the learning experience, enabling the learner to gain a deeper understanding of certain aspects of interest.

The international scene for official education programs has increased since the concept of educating the coming generations, through providing benefits in international curriculum programs or studies and also benefits for the tourism industry. In international programs, students must be able to communicate, whereby language schools step in to offer mostly EFL, TOEFL, or

other programs for fluency in English, DILF/DELF/DALF levels for French proficiency, and recently studies of German and Asian languages. There is an open market for learning as the global economy has adopted English as the language for business (Graddol, 1997). Batchelor (as cited in Ritchie, Neil & Christopher 2003) estimated that 1 million people learn English each year, with the United Kingdom (UK) being the leader in the field by far with a 2 billion GBP market and attracted more than 500,000 people to attend English courses in 1998. A concise point is the opportunity to satisfy modern tourism trends, and travel to new places. The growth of higher education in Western societies combined with the present needs for economic sustainability increases the educational tourism market.

According to Williams (2010), the UK is the largest host for English language study programs; the argument is also based on Millns' (2008) estimation of 380,000 overseas students in 370 centres, generating around 1.2 billion GBP in export revenue. During the period 2007-2008 the contribution made by the Universities UK (as cited in Williams, 2010) and higher-education institutions to the economy was approximately 2.3 billion GBP for off-campus total personal disbursement from overseas students attending university programs, and 135 million GBP from university-related overseas visitors. A report issued by the UK Department for Business, Enterprise and Skills in July 2011 valued the sector of English language teaching at more than 1.9 billion GBP for 2008-2009 (English UK, 2013).

The British Council (2013), represented in more than 100 countries, offers educational programs and language benefits for economic growth in countries such as India, China, Brazil, the Gulf States, Indonesia, Mexico, Turkey, Afghanistan, Pakistan, Zimbabwe, etc. In 2012, it worked with more than 580 million people worldwide; furthermore, in the UK it is also involved with universities offering courses to more than 400,000 overseas students every year. Its estimated export revenue contributes 9.8 billion GBP for the UK economy.

In French et al. (as cited in Ritchie et al., 2003), cultural and educational tourism began with the Grand Tour when scholars and aristocrats visited Italy, France, Germany and Switzerland from the 17th to the 19th century. Traveling for several years was part of the global education process, exposing travellers to foreign civilizations, learning their language and exchanging experiences.

In Ayala's study (as cited in Ritchie et al., 2003), provided by the National Tour Association in 1988, in North America 93% of respondents mentioned the opportunity for learning while traveling as an important factor in their decision to travel. The same author indicated a possible change in tourism demand with tourists becoming more interested in education and learning, making education a "must have" in every trip. This way tourism providers are encouraged to develop more attractive and interesting products, paying tribute to local tangible and intangible heritage.

In relation to having education and learning as a primary or secondary motivation for travel, Ritchie (2009) defined "Educational Tourism" as where users undertake an overnight vacation or excursion. Ritchie et al. (2003) adopted the system "tourism first" and "education first" when describing motivation for travel. Assuming that learning takes place during every travel experience, people with tourism rather than education as their primary motivation can also be interested in learning while participating in active holidays or soft tourism (see Figure 2.4).

The learning process is usually transmitted through cultural or heritage attractions, or natural habitats, referred to as 'Edutourism', which is defined in dictionaries as a form of intellectual stimulation during recreational traveling, or traveling to attend scholar programs.

Education has become a perceived instrument for boosting experiences, incorporating the fast-growing area of travel and tourism. Blended educational programs are used for meetings and conferences, study-abroad programs and educational adventures where participants are motivated to learn through the different formats offered, but all the while being focused on education first.

Learning in natural environments provides additional experiences and usually brings obvious benefits to conservation. Tourism in nature serves the purpose of educating visitors by stimulating their curiosity through the use of environmental education to raise their awareness of environmental issues. Environmental education also featured in the international commitment Agenda 21 at the United Nations Conference on Environment and Development held in Rio. Environmental education can be seen as a form of knowledge transfer based on past experiences of observation and enjoyment of nature. Knowledge and respectful use of natural resources need to keep pace with the development of society.

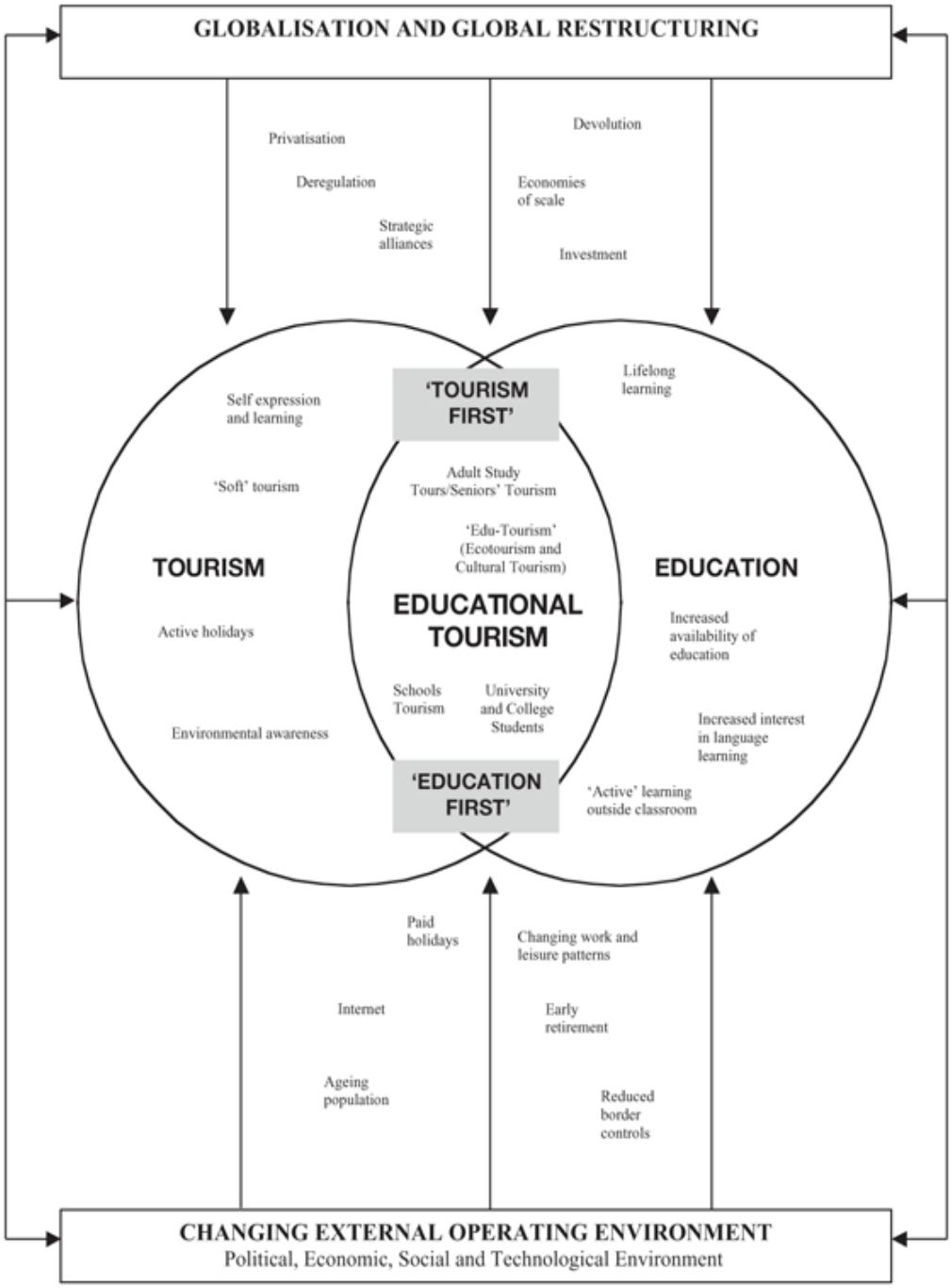


Figure 2.4: External environmental influences on educational tourism. Source: Brent Ritchie (as cited in Williams, 2010), Managing Educational Tourism.

In a study looking into the origins of environmental education, Castillo (2002) described an evolution that took place at the end of the 19th century when students were given greater contact with natural science. Since the 1930s

environmental issues have come more and more to the public's attention. The conservation of natural resources started to be enforced and having place on outdoor environment, exposing students to nature, thereby increasing their awareness. The same author stated that environmental movements started in Europe and North America that pushed for ecology and educational systems centred on ecosystems and biophysical factors.

Environmental education is a continuous process of awareness and knowledge about practices, values and important experiences for decision making (Martin, 1999). Non-formal education can complement professional activity by enhancing the skills needed for success (Case, 1988). This could be offered by private specialized institutions, which could even eventually become more important than official learning programs. Examples of educational tourism include non-formal education programs, which provide tourism experiences in nature in conjunction with the local community. Partnerships are usually created to support local community projects in which include educational tourism activities. Joint programs with local organizations are attractive for foreign participants looking for professional experience, educational summer schools, internships and semesters abroad.

In 20th-century society, the tourism model consisted of taking wealthy tourists to an exotic beach surrounded by palm trees or visiting the local historical centre. New trends and economic development allowed more people to travel, which created the need to change the model. Today visitors are more demanding and interested in learning about the destination and the people they encounter there (Falk et al., 2012).

Traveling extends physical boundaries and opens people's minds, and is an important vector for learning about themselves and their societies. Falk et al. (2012, p.911) analysed opinions of scholars and referred to an apparent discrepancy between traveling and learning, or traveling and education. Despite existing educational programs included being included in tourism experiences for culture, wildlife and ecotourism, there was no reference to "what actually visitors learn, who is learning; and when, where, why and how do travellers learn".

People are motivated to actively participate in learning experiences, perceiving an experiential value while being entertained and collecting benefits during the learning process (Packer, 2006).

According to Falk (2005, p.2) “learning grounds such as museums, science centres, zoos, botanical gardens, visitor centres and nature activities are the most usual sites outside school” for non-formal education programs. Ritchie (as cited in Minnaert, 2012, p.1) stated that “Educational tourism can include special-interest holidays, language courses abroad, and field study trips”. Minnaert revealed that usually this type of non-formal education is more focused on the significance of learning as a motivation instead of what tourists will actually learn from their experience. On the other hand, Ballantyne et al. (2010) expressed that tourism was a valid tool to educate visitors about nature and the threats facing wildlife.

The research presented in this thesis reflects all of the approaches mentioned above for education and tourism experience, and how much behaviour can be changed to reduce the amount of plastic and food discards, in the household. Visitors motivated for “tourism first” and who participate in diving activities, are also introduced to local communities and display an interest in learning by experiencing social interaction and observing impacts on the reef. Participants already have an environmental conscience and attitudes towards the environment; however, additional awareness can still enhance their learning experience. The hypothesis formulated in Chapter 1 is also designed to assess new divers using Richie’s system (“tourism first” and “education first”). Participating in diving experiences can be occasional or intentional, and how much of a role the tourism activity (scuba diving) plays in their experiential learning process will be measured.

2.1.4. Approaching tourism, nature and users

Nature-based tourism is a fast-growing branch of tourism, involving activities and visits to natural areas, which in some cases carry physical and social risks (Cater, 2006), in order to participate in activities and enjoy nature. The very fact of people living in busy cities breaks their linkage with the natural environment and impels them to adopt forms, feelings and habits alien to the natural form of nature. Nature-based tourism attempts to function in balance with the natural environment, taking into account both positive and negative impacts.

There is something of a mutual dependence: Tourism activity requires natural resources for development of the activity and in some way nature “requires human pressure” for conservation and sustainability of the species. That is to say a symbiotic relationship can be developed that prolongs the existence of certain species, and through the use of sustainable strategies the tourism industry can also positively affect the natural environment (Kuenzi, 2010).

Motivation comes from the opportunity to participate in recreational actions focused on nature where natural resources are used for sports activities that require various levels of physical strength (UNWTO, 2001). Ceballos-Lascurain (as cited in UNWTO, 2001) stated that nature-based tourism also includes ecotourism, which describes traveling to less disturbed areas and is focused on educational activities or the consumption of sustainable tourism products. The characterizations have been adjusted for describing the sustainable use of nature with benefits for tourists, local communities and nature.

In some cases, nature-based tourism carries the risk of dependency, impacting directly on local communities and, therefore, a disruption of the activity can negatively affect the flow of tourism and lower a country’s gross domestic product (GDP). Tourism consumers are also exposed to personal health and safety risks when engaging in extreme activities; for example, injuries or fatalities can occur when skiing, rock climbing, rafting, etc. Krakauer (as cited in Kuenzi, 2010) reported that since 1953 over 150 climbers have died attempting to reach the summit of Mount Everest, and Lischenke (as cited in Kuenzi, 2010, p.10) found that during the period 1987 – 1997 there was “an average of 414 fatalities per year” among climbers in the European Alps. Moreover, tourism activity is also conditioned by external risks such as civil conflicts, disease, and fuel price fluctuations, which affects travel and transportation.

Based on studies conducted worldwide on visitor profiles, it is possible to understand their motivation for choosing such forms of tourism and activities. Information becomes crucial for managing nature-based tourism and developing attractive products for each segment. For example, Gordson Sinyenga (2005) profiled tourists visiting Zambia in 2005 and found that nearly 80% of those with a highly paid job were motivated to visit Victoria Falls and consume wildlife tourism. Approximately one third were repeat visitors to Zambia; overall 44% spent more than 6 days in the country and 43% 3 to 6 days, and all were willing

to pay to visit national parks. It is common for tourists to travel based on a tourism package purchased for a limited time; however, 57% of non-package visitors in Zambia were more likely to spend more time and money in the country.

Good management of the abundant wildlife, culture, natural heritage sites and water resources in Zambia boosted tourism activity from 200,000 in 1995 to over 500,000 in 2005. Tourists enjoyed the thrill of close encounters with wild animals, in particular big cats (Sinyenga, 2005).

Since the 1990s, Costa Rica has gained a high position in the nature-based tourism sector (Villalobos-Céspedes, 2012) and according to the Institute for Tourism in Costa Rica (ITC), in 2009, 40% of international tourists are motivated to participate in nature-based activities, accessible in the country's public and private natural parks and reserves. Costa Rica has a high amount of tourism activity, and is well known for being able to provide natural resources 'on demand' such as geological formations, fresh- and salt-water systems and the biodiversity living in rainforests or mangroves, which usually require specialised equipment to ensure safety and enjoyment (Buckley, 2007). The country hosts approximately 5% of the world's biodiversity and over 25% of its area comprises natural parks, wildlife sanctuaries, protected areas, forestry reserves, biological reserves and areas of natural conservation (Villalobos-Céspedes, 2012).

Visitor profiles for Costa Rica (Villalobos-Céspedes, 2012) revealed the majority to be male (62.3%), over 50 years old (43.9%), educated predominantly to university level (56.3%) and married (63%),and arriving mostly from the U.S. (59.8%) followed by Europe (19%). Tourists expressed an interest in holidays, leisure, sports and pleasure (88.2%).There was a considerable percentage of repeat visitors (34.5%), the average length of stay was 11 nights, and the average spend approximately 1,308 USD (ICT, 2012).

Tourists were assessed for the how they travelled, whether alone, with family, friends or a partner. Tourists on a family holiday were 3.14 times more likely to purchase nature-based activities than those traveling alone. Also, tourists not visiting nature parks and reserves had no intention of spending money on nature-based tourism, and repeat visitors were found to be 60% less willing to demand such forms of tourism.

During the recession period of 2008–2009, wildlife tourism registered 1.6% growth. A study conducted in the Kruger National Park in South Africa in

December 2009 identified 6 motivations for consuming wildlife tourism, with the most common being “escape, wildlife experience, and benefits for the family” (Kruger, Scholtz, & Saayman, 2013). Economy issues were not a big constrain for consuming wildlife tourism, backing up Eagles’ (as stated in Kruger et al., 2013, p.8) statement: “visitations to nature areas such as national parks will continue to increase as more people turn to nature tourism”. Also such an increase during a recession can be related to feelings and attractive marketing campaigns. People tend to relate strategic wording for relaxation, get away or stress removal with their actual need, and therefore consume wildlife tourism by visiting a national park.

Countries with natural resources suitable for tourism exploitation run campaigns catering for holidaymakers seeking nature-based tourism, and through this gain a position in the market and become more attractive to visitors in the process. Users tend to have standards, who is willing to travel overseas to experience and appreciate particular natural attributes from a certain region, remaining all the while focused on environmental issues. The continuous increase of worldwide tourism activities requires adequate management and responsibility by both developers and visitors in order to strengthen the relationship between nature-based tourism and users.

The UNWTO issues regular reports on international tourism with representative economic figures and data to support tourism forecasts. In 1993, Sindiga (as cited in UNWTO-UNEP, 2011) reported 23% of the 826,000 visitors to Kenya purchased wildlife safari tourism products; in 2000, nature-based activities represented 75% of “Australia’s international tourism, and 42% of recreational tourism activities in Europe”. The same agency places important economic value on nature-based tourism, which generated 122.3 billion USD for the USA tourism market in 2006. The Centre on Ecotourism and Sustainable Development (CESD) and The International Ecotourism Society (TIES) reported in 2005 that travellers were becoming more willing to pay for nature-based tourism activities and sustainable tourism development, thus to the benefit of local communities and conservation (UNWTO-UNEP, 2011).

Ecotourism structures are driving the growing market, offering pristine areas converted for tourism activities and charging higher prices compared to more mass-market tourism. The prediction for nature-based tourism is that it will double in the next 20 years as long as it is managed well. The development of

artificial environments imitating the original resource, can be taken as a strategy by some managers to respond to the loss of natural habitats and as a consequence of the global changes in the environment. In this case, "resources" become independent and attractive for specific markets (Dwyer, Edwards & Mistilis, 2008).

Examples include underwater sanctuaries such as shipwrecks for scuba diving, which boost local economies and become a shelter for some marine species, which allows them to be observed more easily; or manmade structures used for coral reef restoration where divers can be educated about reef ecology, and alternative strategies for coral reef management. Also theme parks serve as an example of recreating natural environments filled with wildlife allowing the opportunity for divers to swim with tropical fish in a coral reef aquarium; or "recreating" an entire underground world with caves systems and tunnels for "nature-based" activities. In these places visitors can usually learn about the local civilization, culture, nature or geological formations all year round, day and night.

2.1.5. Experiential learning with David Kolb's learning cycle

Psychologists such as William James (1842)[2], Carl Jung (1875)[3], Jean Piaget (1896)[4] and John Dewey (1859)[5] contributed to the building of theoretical bases for learning by "doing". Dewey focused on approaching problem

[2] William James (1842-1910) pioneering American psychologist and philosopher, he wrote influential books on the young science of psychology, educational psychology, psychology of religious experience and mysticism, and the philosophy of pragmatism.
Source:http://ebooks.adelaide.edu.au/j/james/william/

[3]Carl Gustav Jung (1875-1961) made a significant contribution to the psychoanalytical movement and is generally considered the prototype of the dissident through the impact of his scission and the amplification of the movement he created in his turn (analytical psychology).
Source:http://www.carl-jung.net/biography.html

[4]Piaget's (1896-1980) oeuvre is known all over the world and is still an inspiration in fields like psychology, sociology, education, epistemology, economics and law. Source: http://www.piaget.org/aboutPiaget.html

[5]John Dewey (1859-1952) was an American psychologist, philosopher, educator, social critic and political activist. Source: http://dewey.pragmatism.org/

practically by pushing for critical solutions rather than routine learning and memorization, with the learner in the centre of the learning process and not the teacher. Learning with previous knowledge is supported in Kolb's theory through experiential learning, and is the key factor in his Learning Style Inventory (LSI), whereby students are motivated to learn by using personal skills and preferences rather than studying directly from a textbook (NIU, 2011).

Educational programs were influenced by David Kolb's theory, mainly at high-school level. This American organizational psychologist contributed with his important theory, which is used by many institutions, asserting that "learning is the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p.38).

Through first-hand experience in a comfortable environment using personal preference, learners can become more capable to assimilate new concepts and acquire knowledge (Healey & Jenkins, 2000). Already James (1842) quoted experience as the basis of experiential learning, and knowledge would come from our experience.

The original document was produced in 1969, developed originally as an experiential education exercise. Based on individual differences in learning, the theory was designed to assist the understanding of the experiential learning process and respective learning style. As a learner, experience is the guide for the learning process and also expresses when something has been learned. For Kolb, his comprehensive theory represents a lifelong learning process, where according to individual learning preferences or style, learners can enter into a very dynamic learning cycle; for example, more active people will enter the cycle through a concrete experience and people who prefer reflexive methods will enter through observation style. Through observations of an experience, new concepts can be generated and tested in new situations, which closes the four-stage learning cycle (Kolb, 1984).

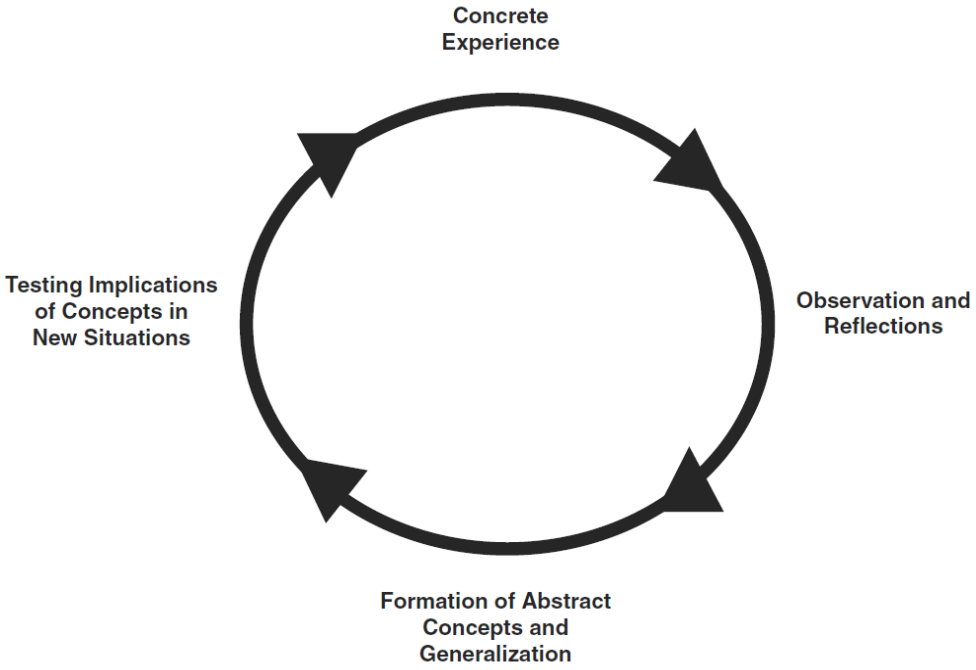


Figure 2.5: The Experiential Learning Cycle, David Kolb 1994. Source: Alice Y. Kolb & David A. Kolb, 2005. The Kolb Learning Style Inventory – Version 3.1.

The process transposes experience into concepts, with individuals reflecting and comparing what they learn with previous knowledge. The first two stages presented in Figure 2.5, Kolb referred to as concrete experience (CE), which is feeling the experience first-hand leading to a reflective observation (RO) of the facts. The model indicates two more stages granting intellectual digestion for abstract conceptualization (AC) of the new observations, and therefore possible practical application called active experimentation (AE). Interpretation plays an important role here in understanding the possible relationship among the facts, and what implications might result from active testing of new experiences.

Kolb, Healey and Jenkins (1984; 2000) characterized the model and stated the possibility of entering the cycle at any stage; no matter where learners enter the cycle the important thing is to continue the sequence and become a more effective learner. Kolb recommended going through every step again.

The presented model runs counter to some traditional school programs or courses which do not take into account previous students' knowledge or experience; it is also a critique on experimentation with insufficient information or

organizational curriculums neglecting reflection and revision of the theory taught (Jenkins, 1997). These procedures strongly affect the model, and learning methods might become much less effective (Healey & Jenkins, 2000).

Kolb (1984) described his experiential learning theory as a process combining four different learning styles (feeling, watching, thinking, and doing) in which individuals can enter the process in any stage, but always adopting a bipolar dimension. Individuals more centred on abstract concepts have the need to experiment with theories to achieve a concrete experience. Another dimension for learning supports individuals in active experimentation and the need for reflection on obtained results.

The four learning styles described by Kolb identify individual preferences for learning and are characterized as convergent, divergent, assimilative and accommodative, see Figure 2.6. Despite learners choosing different learning styles, Kolb (1994) suggested a similarity in solving problems (cited in Healey & Jenkins, 2000, p.187):

- ***Divergers (CE/RO)*** view situations from many perspectives and rely heavily on brainstorming and generation of ideas.
- ***Assimilators (AC/RO)*** use inductive reasoning and have the ability to create theoretical models.
- ***Convergers (AC/AE)*** rely heavily on hypothetical-deductive reasoning.
- ***Accommodators (CE/AE)*** carry out plans and experiments and adapt to immediate circumstances.

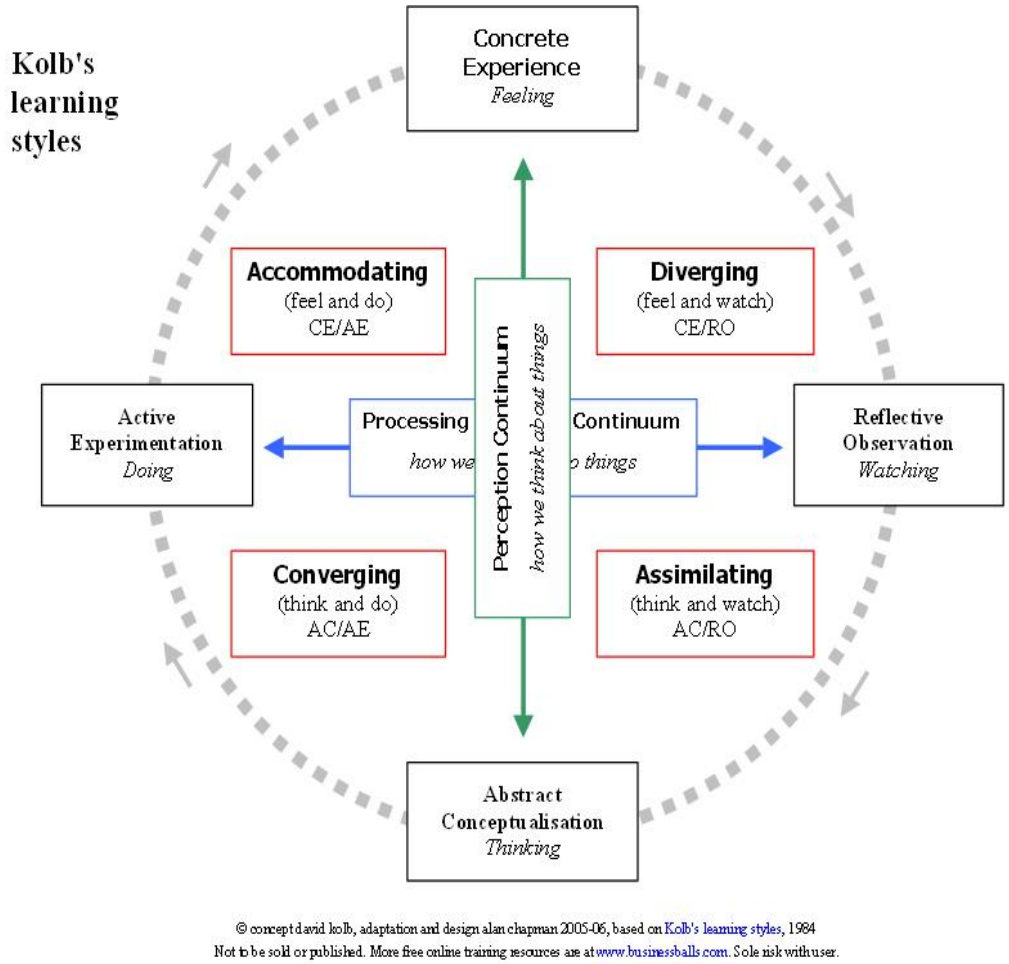


Figure 2.6: David Kolb (1984) Experiential Learning Cycle, and Learning Styles. Adaptation and design by Alan Chapman 2005-06. Source: www.businessbass.com

Since its first edition in 1969 the LSI has been updated 6 times. Information has been shared among researchers in order to provide a more reliable theory; however, Kolb received some criticism about it (1976, 1984) and his bipolar dimensions (for reviews see: Gardner, 2000; Koob & Funk, 2002; Kayes, 2005). Prior to the first revision (1985), several studies were published validating the LSI on different fields of knowledge; however, several studies also identified psychometric weaknesses and theoretical problems. Hunsaker and West (1980; 1982) stated that the LSI received most of criticism as a predictive tool.

Researchers evaluated alternative learning models for comparison with the LSI, and Ferrel (1983, p.39) concluded that “No one instrument stood out as better than the others” and stated also that the LSI was not adequate for

measuring learning styles. Despite this, different authors suggested using the LSI only for descriptive theory; studies cited the LSI as:

"Despite all the criticism, considerable research evidence reports positively on Kolb's work as a means of showing alternative approaches to learning (Raschick, Maypole & Day, 1998)" (as cited in, Metallidou & Platsidou, 2007, p.114).

"Kolb's experiential learning theory is one of the best known educational theories in higher education. The theory presents a way of structuring a session or a whole course using a learning cycle" (Healey & Jenkins, 2000, p.185).

Supporting the hypothesis presented in Chapter 1, the LSI is used in this study as a descriptive tool for guidance in scuba diving training and observation of the sea floor for experiential learning. Based on Kolb's theory and his experiential learning approach, the research model presented for testing the hypothesis can help in predicting divers' behaviours regarding good environmental practices in the household.

2.1.6. Divers' behaviour based on the Theory of Planned Behaviour

The use of technology for waste management benefits civilization and is aimed at providing healthier conditions in the local living surroundings; however, the capacity to respond to such impact is sometimes not achieved by the natural environment. Daily waste production demands a convenient mode of regulation and active participation from the population (Bortoleto et al., 2012). Studying the reasons why citizens participate (or not) in such practices for waste management (for example, waste prevention, garbage separation, recycling, littering, etc.) has led scientists to use theoretical models for understanding such behaviour. From the social point of view, Fisbein and Ajzen (1975, 1980) proposed the Theory of Reasoned Action (TRA), which measures the relationship between behavioural intention and attitude regarding certain behaviour and subjective norms to which people are conditioned.

People displaying positive behaviour and good intentions with their actions have a higher degree of intention and a better chance of displaying the behaviour in question. Ajzen (1985) concluded that behaviour cannot be directly described by behavioural intention alone. To the original TRA is added the variable Perceived Behaviour Control (PBC) as a reflection of two factors: a) the individual conditions can affect an individual to adopt certain behaviour, and b) the individual's perceived ability to adopt a particular behaviour (Bortoleto et al., 2012, p. 2195). The new and updated theory is called The Theory of Planned Behaviour (TPB).

In literature reviews, Fishbein and Ajzen (1975) found a great number of definitions for attitude, for example, they mentioned Campbell (1963) and Greenwald (1968), who picked up the particular measurement of most interest for their research, having to try new definitions for attitude. Judgments for attitude were recorded and measured with scales (for example, Likert[6], Guttman, Thurstone, and semantic differential scales); such an approach was included in statements asking people to measure attitude and behaviours. For instance La Pierre (as cited in Fishbein & Ajzen, 1975) used letters when asking restaurant managers about their behaviour regarding accepting Chinese customers in their restaurant. A different approach was taken by Ostrom (as cited in Fishbein & Ajzen, 1975) who used use a 9-point scale to measure three aspects of attitude on religious feelings and beliefs. Festinger and Carlsmith (as cited in Fishbein & Ajzen, 1975) used an 11-point scale, ranging from "extremely interesting and enjoyable to extremely dull and boring", to rate boring tasks. Fishbein and Ajzen (1975) observed differing attitudes when different measures of "attitude" were employed.

When a person is observed performing the same response to a specific stimulation, it can be considered consistent with his preferences, reflecting his consistent attitude. "Two behaviours are considered to be consistent if both are located on the same side of the dimension; they are inconsistent if they are located on opposite sides" (Fishbein & Ajzen, 1975, p.7). In the long run,

[6]Likert scales were developed in 1932 as the familiar five-point bipolar response format most people are familiar with today. These scales always ask people to indicate how much they agree or disagree, approve or disapprove, or believe something to be true or false. There is really no wrong way to use a Likert scale, the most important thing being to at least have five response categories (for ordinal-treated-as-interval measurement. Source: ~kdbrad2/EDP656/Handouts/Chapter6B.doc

behaviour may be considered consistent overtime when attitudes take place, even different types; however, an evident consistency in responses with respect to an object was not noted. Frequently, the evaluative dimension characterizes consistency, but affective consistency was considered by Thurstone, Suci, Fishbein (as cited in Fishbein & Ajzen, 1975) as an important dimension.

Attitude is commonly accepted as a variable to explain or influence behaviour; however, it cannot be measured directly. There are no ways to measure attitudes if not through observed behaviour and consistency. In the present study consistency was measured through stimulus-response interpretation, whereby divers' responses were assessed before and after exposure to the natural environment. The sea works as a stimulation for a particular response, in this case for plastic consumption and management practices. Already the response-response interpretation requires a predisposition for performing a class of behaviours, either favourable or unfavourable for environmental practices in the household. Positive responses will lead to positive behaviours in the household. For example, Sarnoff (1960) defined attitude as "a disposition to react favourably or unfavourably to a class of objects. … Chave (1928) provided a detailed description of the factors that influence a person's predisposition: A attitude is a complex of feeling, desires, fears, convictions, prejudices, or other tendencies that have given a set or readiness to act to a person because of varied experiences" (Fishbein & Ajzen, 1975, p.9).

Scientists cannot access a person's life-event inventory list; only facts reflecting past experiences can be studied. Reflexes from those experiences are attitudes observed and learned. Predispositions to respond positively are consistent with an individual's positive experiences in the past, leaving room to study residual thoughts reflected on his attitude.

Whereas attitude reflex divers opinion, either favourable or unfavourable about plastic and food discards, beliefs will represent specific information about the same plastic and food discards. Beliefs link objects to attributes, for example, the belief of "using a shopping list" (the object) to "reduce food waste" (the attribute) or "not consuming plastic" (the object) to reduce marine debris" (the attribute). It is normal to have people associate object-attribute. Belief is recommended to be measured by placing the subject along a dimension of subjective probability. The belief that "plastic is the major component of marine

debris" links the object "plastic" to the attribute "is the major component of marine debris".

The presented model conceives behavioural intention by conferring an intention to perform certain behaviour, that is to say, intention influences the probability to perform the behaviour in question. "The concept "attitude" should be used only when there is strong evidence that the measure employed places an individual on a bipolar affective dimension. When the measure places the individual on a dimension of subjective probability relating an object to an attribute, the label "belief" should be applied. When the probability dimension links the person to a behaviour, the concept "behavioural intention" should be used" (Fishbein & Ajzen, 1975, p.13).

Real behaviour carries details obtained from variables such as verbal responses or questionnaires, providing observations of the subject. These inputs are used to interpret beliefs, attitudes or intentions. For research about a specific behaviour, constructs are formed to measure the obvious behaviour in which we are interested in studying and understanding its determinants. Through regular inputs from direct observation or information gathered about a certain object, a person builds their conceptual structure with beliefs as the association between the object and various attributes. For example, divers can hold beliefs about a certain environmental organization that promotes conservation, such as "the environmental organization charges moderate member fees", "the environmental organization runs educational programs", or "the environmental organization promotes awareness", etc. Such beliefs may guide the person to hold a positive or sympathetic attitude in favour of the environmental organization. A set of intentions is triggered which are also favourable for a sympathetic attitude. Thus the person may intend to support the environmental organization, but not start actions to raise awareness in their neighbourhood or carry out fundraising for the environmental organization.

Beliefs about an object sustain specific attitudes toward the same object; adopting good practices for household waste management might be triggered by the belief that doing so makes a positive contribution to the environment. Such an attitude carries the intention to carry out good practices in the household in regard to the environment; in this manner environment-related behaviour is noted and also leads to new beliefs about the environment.

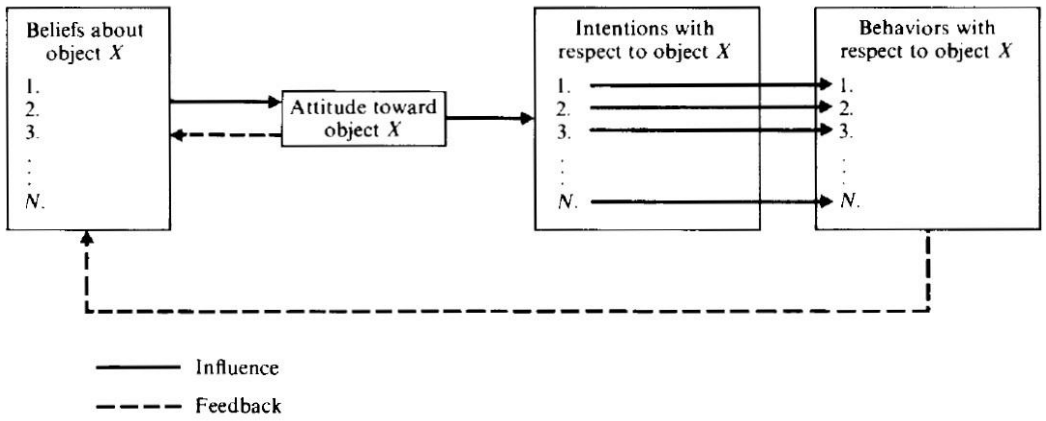


Figure 2.7: Schematic representation of TRA conceptual framework relating beliefs, attitude, intentions and behaviour with respect to a given object (Fishbein & Ajzen, 1975. p.15).

Behaviour and attitude can influence the development of new beliefs (see Figure 2.7), which in sequence influence attitude. Divers' intention is a function of certain beliefs. Attitude and behaviour are strongly linked with personal beliefs about an object (nature); a particular behaviour is perceived as an intention to perform a certain behaviour, which offers feedback for beliefs about possible consequences of a person's conduct and what attitude is taken toward their behaviour.

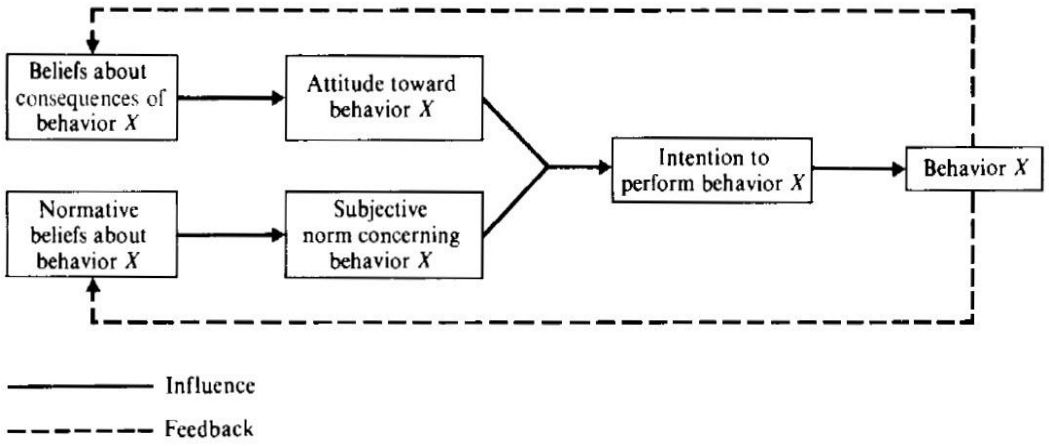


Figure 2.8: Schematic presentation of conceptual framework for the prediction of specific intentions and behaviours (Fishbein & Ajzen, 1975. p.17).

Another important belief is represented on Figure 2.8, which is the normative belief that society, friends, a group of people, or any other referent

think we should perform the behaviour in question. A person shall present their motivation to comply with such referents, and the totality of all normative pressures actually leads to subjective norm concerning behaviour.

Fishbein and Ajzen's (1975) definition requires some form of measurement where responders can place themselves on a bipolar dimension. In Osgood, Suci and Tannenbaum's work (as cited in Fishbein & Ajzen, 1975) such a dimension cannot measure all circumstances as scales have different purposes and thus different meanings. The concept of the question will dictate the influence and accuracy of the scale used. For example, measuring cold and warm is used for show differences in temperature, and for it can be used to know what possible relation has in peoples' lives, adopting a descriptive scale for comfort level. Single response measures the concept along a bipolar dimension, showing affectivity and indicating a certain level of attitude. In the present study, divers were asked to indicate their behaviour regarding consumption of plastic-related products and their respective management in the household (on a scale from "I do it always" to "I never do it"); the behavioural category is a reflex of the intention. Also questions requiring a "yes or no" or "would or would not" type of answer, aiming for intention's content, its strength is given by measuring the probability.

Collecting questions to use with the measurement tool is the first step to setting a Likert scale (or Likert-type). Researchers look for statements describing either beliefs or intentions. Ambiguous statements or the ones presenting neutral attitudes are discarded, leaving only favourable or unfavourable statements to be administered to the target population. On a Likert scale responses can be scored, for example, from 1-5, whereby strong agreements with favourable conditions score 5, and strong disagreements with these conditions score 1. Typically, 5-point Likert scales are labelled "agree strongly, agree, undecided, disagree, and disagree strongly", thus for different label descriptions it is preferable to use the term Likert-type scale. A preliminary attitude will sum across all item scores, with a more favourable attitude earning a higher score.

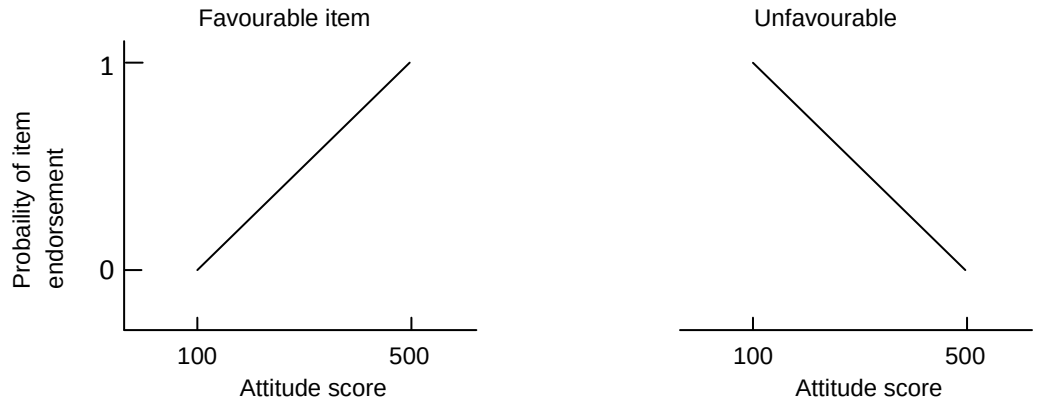


Figure 2.9: Trace lines of favourable and unfavourable of Likert's items (Fishbein & Ajzen, 1975, p.72).

A diver's more favourable attitude is directly related with an endorsement of favourable items; however, unfavourable items score the opposite. That is to say, a diver's attitude is more favourable when it is more likely supported by favourable items. Also diver's attitude scores lower values for unfavourable items, with divers more likely to endorse to unfavourable items (see Figure 2.9). The trace line gives an indication of expectation, confirming the apparent correlation between attitude score and item support.

When analysing the scores obtained using a Likert scale, researchers must count on using error components for the variable or random error, and the constant associated error.

$$x_i = t_i + e_i + e_c \qquad (2.1)$$

The observed score (x_i) is defined by the score t_i associated with the variable error e_i and the constant error associated with it e_c. Good reliability promotes good usage of the construct (see Chapter 3 for reliability). Variable factors such as the divers' mood when engaging in a diving program, local weather conditions, water temperature, etc. can affect responses at different moments, which can reduce the instrument's reliability. Measurements must be validated to guarantee a true score rather than register a perceived socially accepted response. Fishbein and Ajzen (1975) commented on the relation

between standard scales and reliability, and also on Wright (1967), and Robinson and Shaver (1969), in which reliability coefficients were reported to be very reliable for Likert scales. Reliability becomes important for deciding which technique will be used for research.

The theory emphasizes the belief concept as a way to provide critical information for attitudes taken. The divers in the study were assessed for their beliefs which in turn influenced their attitudes and behaviour in regard to plastic and food waste in their household. The belief of plastic being found among marine debris and its negative impacts are measured by the divers' attitudes. Beliefs are related to personal understanding and the surrounding environment. For example, divers can see food containers floating in the sea or even fish mistaking plastic for food; these direct observations form part of the divers' descriptive beliefs about plastic (an object). People assimilate the information/observation as valid and "true".

Interactions with another person form beliefs which go beyond observations. During a diving experience, the guide or instructor plays an important role, not only regarding safety, but also by providing important information about the local environment and species on the reef. Unobservable characteristics are learned from another person who we usually trust and from whom we appreciate information about, for example, perception of marine life on the reef: anemone fish are small and cute but territorial; they can display "aggressive" behaviour when defending their anemone but are harmless to divers. Behaviour can be learned from unobserved events reported by the diving guide. So we assume a reason for behaviour and automatically extend it to all anemone fish. Another way to go beyond observation is for instance observing that coral structures depend on polyps and polyps depend on temperature; divers may also form the belief that coral depends on temperature.

Fishbein and Ajzen (1975) called beliefs that go beyond direct observation, inferential beliefs or prior inferences. Many of our beliefs have an external source, which we tend to rely on; they include books, magazines, television and friends. If our diving instructor explains why touching marine life creates a negative impact, we may form the belief that touching disrupts marine life on the reef. We accept information from an outsider (informational beliefs). Thus a direct observation of the unlikely event of riding a turtle or whale shark (bad behaviour, please do not do it) will create stress to the animal and make it

swim away disrupting its natural routine, which could be cruising, feeding or a mating ritual. This object-attribute relation leads to a descriptive belief that outside information that links the object (touching) to the attribute (disrupt marine life on the reef) might or might not form an informational belief.

The Theory of Planned Behaviour (TPB) is an extension to the TRA model containing the foundation of the previous theory, including general attitudes toward physical attitudes, and attitudes toward performing a particular behaviour (Ajzen, 1991, 2012). The author established compatibility in describing verbal attitudes and clear actions, in the process filling a gap from the previous theory where "attitude and behaviour are compatible in terms of their action, target and context and time elements" (Ajzen, 2012, p.445). A specific behaviour can be measured along four actions: Divers can reduce waste (action) by bringing less plastic products (target) into their household (context) for the next 2 months (time). However, general attitude is not compatible with all actions as attitude only identifies the target, lacking the remaining actions and being responsible for a low relation between general attitudes and specific behaviours. Performing a singular behaviour does not necessarily mean that is a daily standard action. General attitudes applies to a certain target "generalizing across actions, context and time elements" (Ajzen, 2012, p.445).

Through attitude, the TRA predicts individual behaviour, but is too strict at predicting and explaining all types of social behaviour. Ajzen (1985) included a new variable in his model to help predict behaviour as the intention to perform a certain behaviour should be controlled in order to overcome situations that might interfere with behavioural performance. People perceiving the ability to perform a given behaviour and are in control and respond to the new variable "Perceived Behaviour Control" (PBC). The original model was limited in dealing with behaviour where individual's intention was a central factor in the model; intentions are indicators of someone willing to perform a certain behaviour. "As a general rule, the stronger the intention to engage in a behaviour, the more likely should be its performance. … Behavioural intention can be expressed only if the behaviour in question is under volitional control" (Ajzen, 1991, p.181). Individuals must be free to decide whether or when to perform a certain behaviour; the new theory adds the novelty of achieving behaviour through motivation and ability to perform (intention + behaviour control).

Ajzen's (1991) understanding of perceived behaviour control differed from Rotter's (1966) definition of perceived locus of control, which pointed to the ease or difficulty in adopting certain behaviour and is directly related to factors for a singular behaviour. A person may believe in the consequence of their behaviour (internal locus of control). More similar to Ajzen's definition is Atkinson's (1964) approach when revealing the factor for expectancy of success, "as the perceived probability of succeeding at a given task" (Ajzen, 1991, p. 183). In Albert Bandura's (cited in Ajzen, 1991, p.184)"social cognitive theory", the ability to control events that could affect peoples' lives is approached by "judgments of how well one can execute courses of action required to deal with prospective situations". Peoples' beliefs are a function of human motivation and action; the perceived self-efficacy confers the ability to perform a certain task.

Ajzen's ***perceived behaviour control*** relates to beliefs, attitudes, intentions and behaviour (see Figure 2.10). The new variable defines confidence and intention to perform a task, the aim of achieving success. A person can sense the difficulty level of the task and when they are committed to completing it, success is achieved through gaining control of the various factors. Also PBC can be an alternative to actual control. Only in a situation where someone possesses little information about the behaviour to perform, will the behavioural prediction be less accurate. PCB is the sum of all control beliefs (c_i) and it can be used together with intention of using good practices for waste management to predict behaviour in the household.

$$PCB \ \alpha \sum c_i p_i \qquad (2.2)$$

Adapting the new variable to the study of divers using good practices for waste management in the household, PCB brings personal perception (p_i) of the ability to perform good practices for waste management.

Control beliefs involve the perception of factors that may facilitate, or not, the use of good practices for waste management. Having the need to purchase certain types of plastic products because there are no others on the market and the frequency of garbage collection can influence waste management practices.

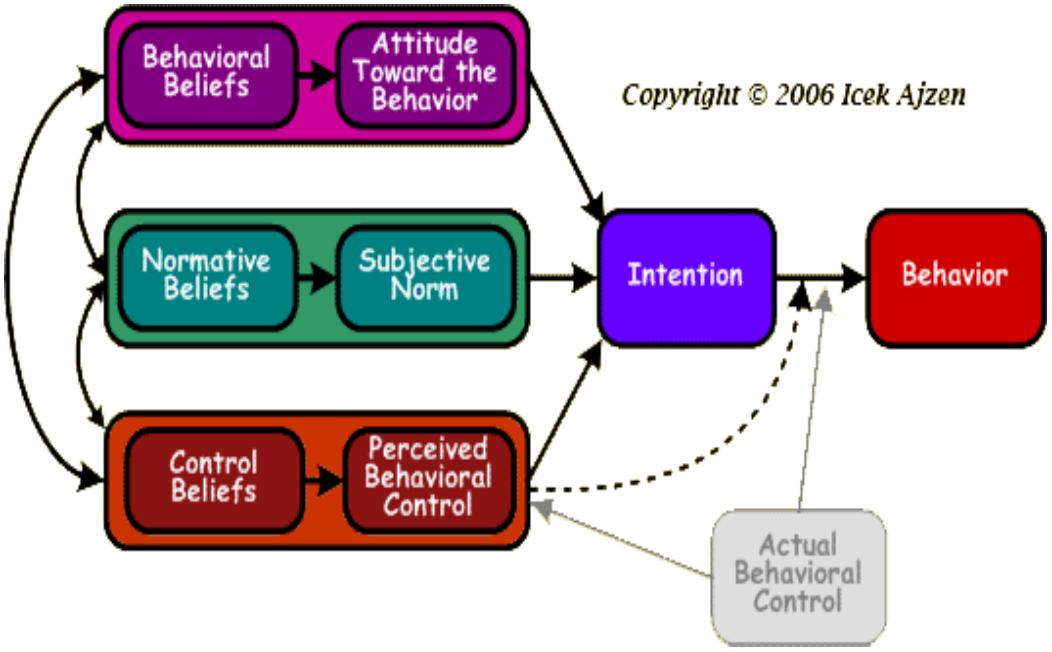


Figure 2.10: The Theory of Planned Behaviour by Icek Ajzen, 2006.

For reducing marine debris ***Behavioural beliefs*** link the behaviour of adopting good practices for waste management in the household, to expected consequences of that same behaviour. This belief is the emotional probability that the specific behaviour will have consequences.

Attitude toward the behaviour is the degree to which performance of good practices for waste management in the household is positively or negatively valued. A person believes that "using a good shopping list" (behaviour) "reduces food waste," by changing their shopping habits to only buying products that are needed (outcomes). The attitude toward behaviour is ruled by the person's evaluation of the consequence of his behaviour and how using a shopping list influences his decision to behave. Furthermore, the estimate of attitude toward the behaviour (A_B) is a sum of all beliefs (b_i) about the specific behaviour, multiplied by the person's strength and outcome (e_i).

$$A_B \alpha \sum_{i=1}^{n} b_i e_i \qquad (2.3)$$

Normative beliefs refer to a perceived behavioural expectation from the surrounding society, or groups of people or referents. In regard to the issue of waste management, it is what we perceive people expect us to do for garbage separation and not to drop litter, etc. When combined with personal motivation, conducts to subjective norms for a certain behaviour.

Perceived social pressure leads to ***subjective norms*** to employ or not to employ good practices for waste management in the household. Subjective norms (SN) are also associated with beliefs, but of a different nature, namely the individual's belief (b_j) of what other people think he should do. The same example of waste management can describe the situation where an individual should separate garbage and dispose of it accordingly instead of dumping everything together in the same bin. The individual is subjected by norms imposed by the society where he is living and he is motivated (m_j) to comply; he perceives social pressure to perform the behaviour. Regarding social expectations, subjective norms are the sum of all accessible normative beliefs.

$$SN \alpha \sum_{j=1}^{n} b_j m_j \quad (2.4)$$

In contrast, if the individual is surrounded by people who do not perform the same behaviour for garbage separation and disposal, he will receive external pressure to not dispose of the garbage accordingly. He will not feel motivated to comply with waste management rules.

Intention is an indicator to perform good practices for waste management in the household. Coming immediately before behaviour, intention is based on the attitude to using good practices for waste management, subjective norms and perceived behaviour control.

Actual behaviour control refers to the magnitude of pre-requisites to use good practices for waste management (personal skills, resources, etc.). Only divers who are sufficiently aware of their capabilities and/or difficulties (control), and have a positive intention to use good practices for waste management in their household will perform the respective behaviour.

Behaviour is what is expected to be measured and observed for waste management in the divers' household. The behaviour of using good practices is a function of suitable and consistent intentions, and also personal perception and ability to perform such practices. Strong and favourable intentions produce behaviour only when perceived behaviour control is also strong. For example, in a very small apartment (an example of a living facility) with reduced space for storage, located near a garbage point that does not separate waste, positive behaviour can be performed using a strong will to be well organized and purchase only relevant products for the household. When possible, the individual must locate a facility to dispose separated waste, otherwise it becomes impossible to perform the required behaviour due to the lack of such facility; the individual cannot control this fact. This situation can be well accepted by the local community which does not put pressure on the behaviour. Also there is the possible technical scenario related to the inefficiency of collecting separated waste and disposing it accordingly, which is also a factor that the individual cannot control. All garbage will be disposed in the same bin, increasing the chance of ending up as marine debris.

The TRA explains how humans behave based on available information and the use of appropriate manners. People have the intention to act in a certain way, but in the long run information must be updated otherwise the frequency of behaviour can diminish; intentions can change leading thus to a change in behaviour. According to the theory, predicting behaviour requires two conditions: First, intention must reflect the diver's intention to perform a certain behaviour in their household; second, behaviour must be controlled by the diver's decision or commitment to perform the required behaviour. Already the TPB has shown performance for social behaviours linked to a certain degree of commitment to performing the behaviour; moreover, internal and external factors might interfere with the action. Skills, abilities, opportunity and will power are necessary for achieving success, but are not always verified as we do not have all the attributes for every situation, which then leads to us not performing the behaviour.

2.2. Municipal solid waste: Potential land source of marine debris

Due to the rapid development of countries, a huge amount of waste is produced daily, and has become a major concern for governmental authorities worldwide (see: Barr, Gild & Ford, 2001, 2004; Barr, 2007 as cited in Swami et al., 2011). For example, in Great Britain the Department for Environment, Food and Rural Affairs (DEFRA) estimated that 28.5 million tons of municipal solid waste (msw) was produced in 2007 and 2008, with 88.7% created in households.

In the Organisation for Economic Co-operation and Development (OECD) Fact book 2013 for Economic, Environmental and Social Statistics, the definition for municipal solid waste is quite explicit and it can be read as follows (OECD, 2013, p.174):

"Municipal waste is waste collected and treated by or for municipalities. It covers waste from households, including bulky waste, similar waste from commerce and trade, office buildings, institutions and small businesses, yard and garden waste, street sweepings, the contents of litter containers, and market cleansing waste. The definition excludes waste from municipal sewage networks and treatment, as well as waste from construction and demolition activities."

The environmental and health indicator is measured through the weight (kg) generated per capita every year (see Figure 2.11). Member countries provide data for issuing annual reports, which are not constant and regular in every country, although the numbers are quite representative and the yearly rank shifts with the introduction of the most recent value provided by the participating governmental agencies in charge. The cases where msw operations in terms of commerce, trade, recollection and separation are undertaken by the private sector carry issues for representing the actual situation. In some cases the reference year available is inaccurate as it does not tally with the latest edition of the OECD fact book.

Data published in the OECD annual report are merely orientative as many countries, like New Zeeland, only report their landfill waste without separation and recycling; for example Portugal refers to its continental surface and islands, and China does not cover rural areas. The OECD registered 650

million tons of msw in 2010, giving an average of 540 kg per capita (see the green arrow in Figure 2.11), and had the U.S.A. leading with over 720 kg per capita (see the red arrow in Figure 2.11); the temporal curve has risen strongly since 1980 (OECD, 2013).

Just because items are discarded it does not mean that waste has no commercial value. There is always a suitable management system for collection, separation, treatment, recycling and disposal. Different countries use different technologies for waste management and the recovery of msw is only targeted if it is in the respective nation's interest.

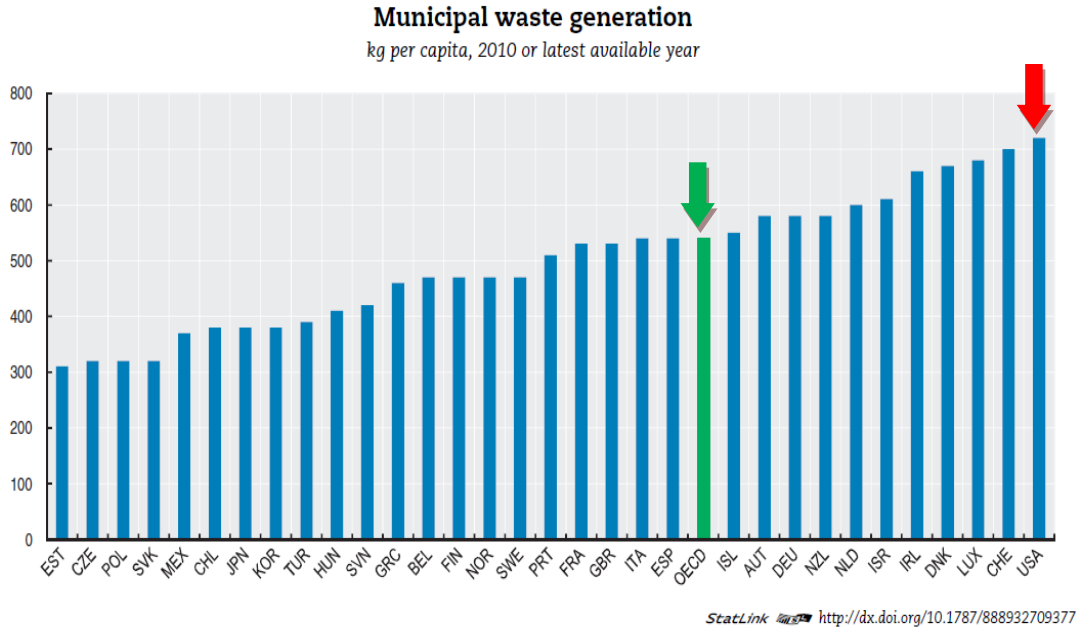


Figure 2.11: OECD ranking for municipal solid waste, published in the OECD Fact Book 2013.

On this topic Barr (2007, p.439) stated the following: "a very crude stereotype… young, females, single family dwelling, high income earning, well educated, and politically liberal individuals, tend to play an active part in waste management activities". In previous studies conducted by Barr et al. (2001) an inverse relationship was found for distance to a recycling site and individuals' behaviour. That is to say, the more distant the recycling facility is from the

household, the lower the effectiveness of the recycling behaviours observed of citizens in using the service provided for removing municipal solid waste.

A common practice for transferring the “problem” of ordinary garbage, normally produced in social settlements, is to burn or bury it. Accepting the fact that neither is good for the environment, society has the need to manage the issue in a responsible way by setting environmental laws and building facilities where garbage can be “eliminated”.

Incinerators can provide an easy solution, with attached energy benefits; however, there is the need to measure the impact created through the burning process. Incineration releases particles into the atmosphere in the form of ash, which is carried away with the wind and can travel long distances from the source. Such emissions contribute to pollution in lakes, oceans, atmosphere and cities, and to global warming. Developed countries have developed expensive technology for maximizing energy efficiency; they also carry the responsibility to use filters and systems for removing pollutants from their emissions. The disposal of generated waste has its final destination in a landfill.

Environmental policies can be implemented, but the problem of how to deal with waste needs to be tackled by both industry and consumers. Environmental impacts can be minimized through good practices for waste management. Citizens can be made more aware of environmental problems though the publication of more objective reports on the effect, educational programs in schools, non-formal education experiences, and environmental campaigns.

2.2.1. Environmental Protection Agency reporting household waste

The Environmental Protection Agency (EPA) collected data for msw collected from 1960 through 2011. The data are useful for managers and policy makers and also serve as a good reference for research that looks at the msw in U.S. along the last 50 years. The last year available (2011) for data analysis registered 250 million tons of msw, which is a reduction compared to the previous5 years. In the U.S. and excluding composting, 66.2 million tons of msw

was recycled, which is a slight increase of 5% compared to 2007. On the other hand, food waste and yard trimmings for composting decreased by 5%.

The United Sates still has a high index of msw generation of 1.99 kg (4.40 lbs.) per person and per day, which is 6% less compared to 2007 (see Figure 2.12). The index variability is strongly related with economic fluctuation, which is a strong reflection of the consumption of goods and thus waste for each temporal array.

Msw has been associated with operations for generation, recycling and disposal, and there has been a continuous increase in the total amount of annual msw produced; however, there has been a gentle decline since 2007. From 1.21 kg (2.68 lbs.) of msw generated in 1960, daily production had risen to almost 2 kg per capita by 2011, reflecting consumer behaviour and a strong dependency on single-use products. Several factors contributed to such an increase, particularly that the world's population was 2.4 times larger in 2012 than 1960 (PRB, 2012).

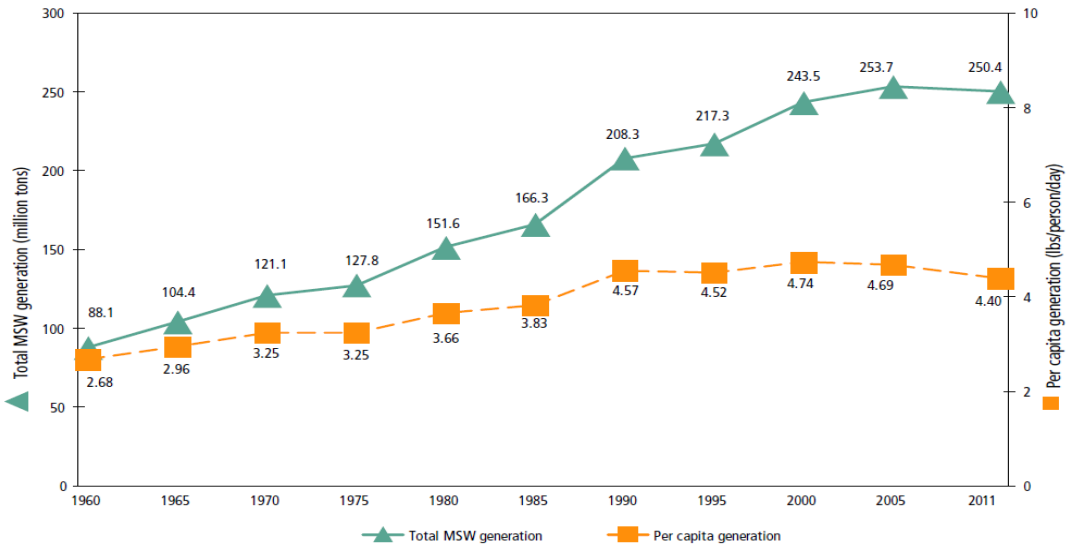


Figure 2.12: Municipal solid waste generation rates in USA, 1960 – 2011 (1 lb = 0,454 kg) Source: (EPA, 2011).

Other factors are the rise in disposable income as well as the use of plastic-related products and so-called clean products, which are typically described as light, safe, easy, or suitable for preventing cross-contamination

(e.g., food containers). Municipal solid waste has actually become a greater contaminant and volume generator than previous discards. Perhaps stricter rules for food safety, transport and handling triggered this growth until governmental agencies realized the urgent need to deal with the issue.

By breaking down the 250 million tons of msw generated in 2011 by weight per category, Figure 2.13 provides a more realistic idea of its distribution. Paper and paperboard represented the highest proportion of msw with 28% of the total weight, and referring to the objectives of this thesis, U.S. citizens contributed 14.5% of food discards and 12.7% of plastics.

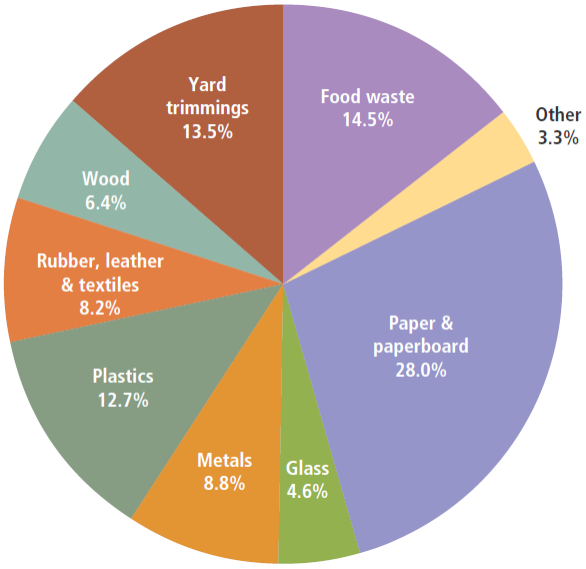


Figure 2.13: Materials generation for 250 million tons of msw, before recycling in 2011, USA (EPA, 2011).

The EPA characterizes U.S. msw in two categories: material, as shown in Table 2.2, and product base. Materials with a high return value lead the table, registering higher percentages of recovery by weight generated. The table highlights the low importance placed on plastic and food waste for being reused or recycled, counting alone with isolated actions within the country.

Table 2.2: Generation, recovery and percentage of recovery from weight generated. Discards of msw materials in 2011.

Material	Weight Generated	Weight Recovered	Recovery As a Percent of Generation	Weight Discarded
Paper and paperboard	70.02	45.90	65.6%	24.12
Glass	11.47	3.17	27.6%	8.30
Metals				
Steel	16.52	5.45	33.0%	11.07
Aluminum	3.47	0.72	20.7%	2.75
Other nonferrous metals*	1.96	1.34	68.4%	0.62
Total metals	*21.95*	*7.51*	*34.2%*	*14.44*
Plastics	31.84	2.65	8.3%	29.19
Rubber and leather	7.49	1.31	17.5%	6.18
Textiles	13.09	2.00	15.3%	11.09
Wood	16.08	2.38	14.8%	13.70
Other materials	4.59	1.28	27.9%	3.31
Total Materials in Products	*176.53*	*66.20*	*37.5%*	*110.33*
Other wastes				
Food, other**	36.31	1.40	3.9%	34.91
Yard trimmings	33.71	19.30	57.3%	14.41
Miscellaneous inorganic wastes	3.87	Negligible	Negligible	3.87
Total Other Wastes	*73.89*	*20.70*	*28.0%*	*53.19*
TOTAL MUNICIPAL SOLID WASTE	***250.42***	***86.90***	***34.7%***	***163.52***

Includes waste from residential, commercial, and institutional sources.
* Includes lead from lead-acid batteries.
** Includes recovery of other MSW organics for composting.
Details may not add to totals due to rounding.
Neg. = Less than 5,000 tons or 0.05 percent.

Source: EPA, 2011.

Only 8.3% of plastic, which is highly representative product among msw, is recycled, leaving a huge amount to be disposed of. It is necessary to run campaigns based around terms such as refuse, reduce, reuse and recycle. U.S. technology must be upgraded and new investments must allow more plastic landings for reuse and recycling. Besides refusing to use plastic products, an alternative for minimizing the amount of plastic is, for example, the eco tax introduced in the U.S. through the Trash Reduction Act of 2013, which for 1 year (2014 – 2015) will impose a charge of 5 cents on single-use plastic and paper

bags at grocery and retail stores. The whole idea is to discourage users from using this type of product, reduce littering and encourage the use of reusable bags. This will take effect on January 1 of 2014 and “not later than December 31 of 2015, the Comptroller General of the United States shall conduct a study on the effectiveness of the provisions of this Act at reducing the use of disposable carryout bags and encouraging recycling of such bags” (H.R.1686 - Trash Reduction Act of 2013, 2013, pp.9,10). This might be away to get people to participate more actively in good practices for waste management. Research can demand urgent alternatives to the current practice, which would benefit everyone. Also only 3.9% of food discards is recovered as a percentage of weight generated.

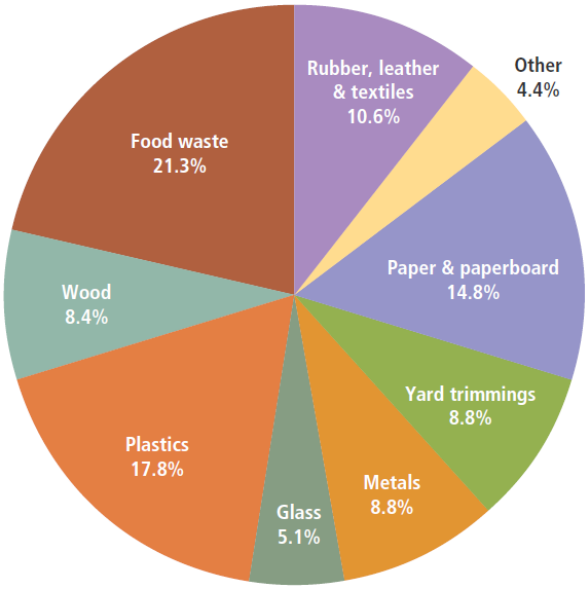


Figure 2.14: Material discards in msw, 2011 - 164 million tons after recycling and composting (EPA, 2011).

During 2011, food waste (21.3%) and plastic (17.8%) were the most discarded materials after operations for recycling and composting msw (see Figure 2.15). The objective of this research requires being focused on updated values for plastic and food waste contained in U.S. msw. The major argument for decision of the materials reside in Table 2.2 and Figure 2.14, where discards are portrayed accordingly and targeted as a potential focus of marine debris. Food-

related products are widely displayed for commerce in plastic containers, and often used for takeaway drinks and meals and come in a variety of forms like drinking straws, plastic disposable cups, water bottles, plates, single-use cutlery, plastic wraps and plastic bags.

2.2.1.1. Plastic disposal

Plastic matrix polymer was invented by Alexander Parks in 1839 and first presented to the public in 1862 during the Great International Exhibition in London, UK. Today plastic is used in the majority of products highlighting it as a great utility in modern times; however, this also means there is a strong dependency on it. Plastic contains additives for coloration and to change its physical properties, and can be either harmless or toxic as they are not bound chemically to the material. Additives can be transferred in and out of the plastic, and in some cases represent a substantial proportion of its weight. Plastic polymers are mostly derived from petrochemical compounds and typically have high molecular mass (Wurpel, Van den Akker & Pors, 2011)

Since its invention a range of derivatives has been available in the market such as rubbers, polyvinylchloride (PVC) in 1872, low-density polyethylene (LDPE, 1935), nylon (polyamide, 1935), polypropylene (1951) and liquid-crystal polymers (1985). A study conducted by Subramanian (2000) about municipal solid waste in the U.S. mentioned the increase of plastic as a component of msw from 0.5% (1960) to 12% (1996) over 36 years. Although the timeframe is long it covers the initial period when plastic products started being introduced, for example, into industrial processes for desalination and removing bacteria, and wastewater treatment plants. It has also been approved for food items, medical use and much more (see Table 2.3 for further applications of plastics).

With the development of electronic equipment and expansions into new markets, plastic has earned a significant position as a material for manufacturing, integrating components for creating new technologies, and daily consumption goods. However, it has also contributed to increasing the volume of waste, and contains addictive contaminants that make their way into the

environment. A new need has arisen to design an adequate system for identifying the different types of disposed of plastic, separating plastic from other components, and purifying or neutralizing the contaminants before disposal.

Table 2.3: Synthetic plastics in use.

Plastic	Use
Polyethylene	Plastic bags, milk and water bottles, food packaging film, toys, irrigation and drainage pipes, motor oil bottles.
Polystyrene	Disposable cups, packaging materials, laboratory ware, certain electronic uses.
Polyurethane	Tires, gaskets, bumpers, refrigerator insulation, sponges, furniture cushioning, and life jackets.
Polyvinyl chloride	Automobile seat covers, shower curtains, raincoats, bottles, visors, shoe soles, garden hoses, and electricity pipes.
Polypropylene	Bottle caps, drinking straws, medicine bottles, car seats, car batteries, bumpers, disposable syringes, carpet backings.
Polyethylene terephthalate (PET)	Used for carbonated-soft-drink bottles, processed meat packaging, peanut-butter jars, pillow and sleeping-bag filling, textile fibers.
Nylon	Polyamides or nylon are used in small bearings, speedometer gears, windshield wipers, water hoses nozzles, football helmets, racehorse shoes, inks, clothing parachute fabrics, rainwear, and cellophane.
Polycarbonate	Used for making nozzles on paper-making machinery, street lighting, safety visors, rear lights of cars, baby bottles and for housewares. It is also used in sky-lights and the roofs of greenhouses, sunrooms and verandas. One important use is lenses in glasses.
Polytetraflouro-ethylene (PTFE)	PTFE is used in various industrial applications such as specialized chemical plants, electronics and bearings. It is met used in the home as a coating for non-stick kitchen utensils such as saucepans and frying pans.

Source: Vona et al. (as cited in Aamer Ali Shah, et al., 2008, p.249).

The challenge of how to manage the diversity of plastics in such quantities has led to action plans being developed to deal with the issue, and studies have been conducted to examine the different phases in the plastic lifecycle and determine how to reduce the amount of plastic at source. The use of less plastic for manufacturing products has reduced the weight of soft-drink bottles by 25%; 1-gallon jugs are now 30% smaller than there were in 1980.

Compared with materials like glass, paper and aluminium, plastic requires less energy for manufacture, use and disposal. Furthermore, efficient manufacture contributes to reducing waste significantly.

The American Plastics Council (APC) published the Recycled Plastic Products Source Book in 1996 to help consumers identify products made out of recycled plastic. A new industry then began for recycling specific plastic-derivative products as the use of some recycled plastics started to be used in many products. Plastics are durable materials, which is one of the reasons why they can be found it so many industrial products, housewares, packaging, etc. However complex technology is required to recycle them due to the variety of additives and different components mixed into the polymer.

The consultancy and research institute IMSA Amsterdam (2011) in Holland, estimated that 30% of packaging and single-use items worldwide are made from plastic; the figure for Europe is 39% and 40% for the follow markets: “building and construction, automotive, electrical and electronic equipment, smaller markets include sectors such as furniture, agriculture, medical devices and household products (toys, leisure and sports goods)” (Wurpel et al., 2011, p.15).

The consulting company Moore Recycling Associates Inc. surveyed the American population about its access to recycling and plastic collection programs. The firm is a leader in assisting businesses, governments and communities with research and development of post-consumer programs. In the U.S. 53% of the population lives in cities with a least 10,000 inhabitants, and 9.3% in cities with less than 10,000, described as incorporated areas, and the remaining 37.7% in unincorporated areas.

An update report (2013) on access to recycling of specific plastics in the U.S. found, as a result of the plastic collection program, “3,903 cities and counties, representing 84% of the American population living in incorporated areas, and 82% of the population living in unincorporated areas. Introducing 1806 cities and 824 counties in the program, reveals that 94% of the American population has access to PET and HDPE bottle and cup recycling, and only around 57% can accede to, at least, plastic bottles and non-bottle rigid container. Americans have access to plastic bottle recycling, but the recycling rate for PET and HDPE bottles is only 30%” (Moore Recycling, 2013, pp.2,5,11). This confirmed that having access to curb-side recycling does not mean that

products are being effectively disposed of for recycling. Local populations must be more active in participating in waste management programs, which should also be revised for better efficiency.

Plastics and discards that are not absorbed by a recycling program are eventually disposed as msw and transferred to the local landfill. When it is sitting on the curb or any other location awaiting collection, it has the potential to become marine debris. This is because it is exposed to external factors such as rain, wind and animals seeking food, and can easily run-off into water streams, rivers or basins and eventually become active as marine debris.

Plastic derivatives with lower density than sea water such as polyolefins like polyethylene (PE), low-density polyethylene (LDPE), high-density polyethylene (HDPE), linear low-density polyethylene (LLDPE), polypropylene (PP), polymethylpentene (PMP),polybutene-1 (PB-1); polyisobutylene (PIB), ethylene propylene rubber (EPR), ethylene propylene diene monomer (M-class) rubber (EPDM rubber) tend to float on water bodies, others such as PVC's, polyethylene terephthalate (PET), polyurethane (PUR) and polystyrene (PS), are heavier than sea water and show the tendency to sink to the bottom or remain suspended in the water column.

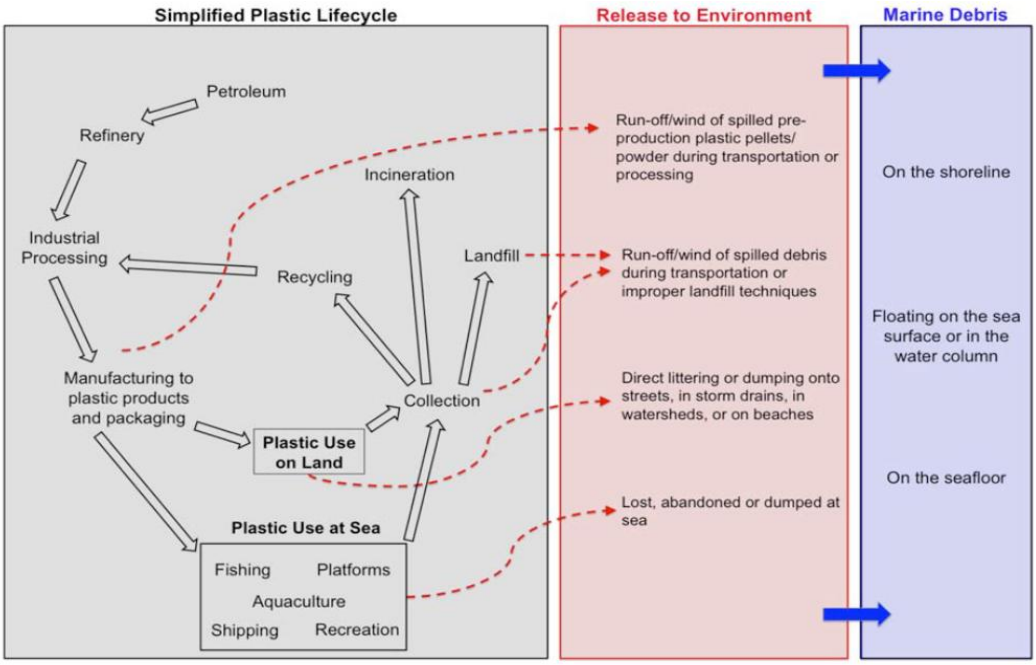


Figure 2.15: A simplified diagram of the lifecycle of plastic and a selection of ways in which it becomes marine debris. Source: Stevenson (as cited in Wurpel et al., 2011).

Stevenson (as cited in Wurpel et al., 2011) produced a simplified description of the transfer process and possible ways for plastic to enter the marine environment. Figure 2.15 identifies potential anthropogenic sources, with origins on land when manufacturing and handling plastics, and other types of sources with origins at sea (example: fishing activity, aquaculture, shipping, recreation or offshore platforms).

Petroleum-based products require industrial processing methods for obtaining different fractions at the refinery; such products have a variety of applications (see Table 2.3) in the many plastic-derivative products used in daily life. Plastic has a major presence in the market, being found in electronic components, car manufacture, goods packaging and food ware, etc. The use of plastic-derivative products has become 'inexpensive' so that all industries have become dependent on it.

The high demand for plastic-related products has increased the run-off of small pellets or powder during transportation and manufacturing. Losses during this process contribute significantly to the negative impacts on the environment. Plastic in such smaller sizes can easily travel with the wind or get carried by water systems until they reach the sea. Small-sized plastic can be mistaken by marine creatures for food and thus intensify the impacts created.

After being transformed, plastic has a wide range of applications inland activities, as we strongly depend on plastic products and it is common today to live among "plastic". For example, food-grade plastic products have been standardized and approved for packaging and wrapping, creating a certain sense of security, yet it is environmentally irresponsible. Land disposal of msw adheres to a whole system for placing waste bins at specific locations where the population can actively participate in disposal practices. Also collection points for waste separation are usually available for important materials, materials with economic value or those which can be recycled. Sitting in landfills are tons of plastic bags containing all discards that could not be absorbed for reuse or recycling; landfills require large areas leading to long-term management issues.

In the 1980s biodegradable plastics offered a new strategy for waste management, and research was undertaken on bioplastics capable of being decomposed by specific microorganisms. Bio-engineering produced innovative combinations of methods for obtaining biodegradable polymers, such as polyhidroxyalcanoatos (PHA), from microorganisms produced from sewage with

specific characteristics and under certain operational conditions for the growth. Biopolymers can replace part of the traditional synthetic plastic, at least in some fields (Aamer Ali Shahet al., 2008). Designed for breaking down polymers in landfills where essential conditions are met, the biodegradation process takes a lot less time than the degradation process for synthetic plastics, making it a viable solution. Polyester polyurethane– polyethylene with starch blend – are biodegradable polymers and are becoming more frequent in their usage as plastics, although synthetic polymers are cheaper and more common but take decades to degrade.

Unmar and Mohee (2008) appealed for the use of bioplastics on Mauritius due to time difference for biodegradation of such polymers, and also suggested using them as a composting technique for recovering nutrients and reducing space in the landfills. Waste management on islands also requires wide areas for waste disposal. Even islands with low numbers of permanent residents see their populations swell with the arrival of tourists, thus exacerbating waste issues.

Little is known about plastic biodegradation in water (Bernhard, Eubeler & Zok, 2008).Experiments in marine environments showed lower rates for biodegradation in comparison with other mediums like freshwater/wastewater and soil or compost. Marine tests revealed the need for longer contact time for digesting polymers (Eubeler, 2010). Bioplastics were recently used in a vast range of commercial products, and are even being made from biological compounds. However, they will flood the seas as marine debris; marine animals will still be entangled by them and mistaking plastic as food. When ingesting bio-plastic, the impact created on the animal is catastrophic; the environmental impact is enormous and the problem must be continuously addressed by industry and the whole of society.

2.2.1.2. Food waste

As waste discards are potential sources of marine debris, it is important to examine the simplified plastic lifecycle as described by Stevenson (as cited in Wurpel et al., 2011), which is depicted in Figure 2.15.Today, food-related items often come in plastic containers and wrapping. Food production has a major

impact on the environment which sometimes goes unmeasured. After recycling, the main component of U.S. landfill is food, not valuating the potential of this waste.

"Getting food from the farm to our fork eats up 10% of the total U.S. energy budget, uses 50% of U.S. land, and swallows 80% of all freshwater consumed in the United States" (Gunders, 2012, p.1).

The United States Department of Agriculture (USDA) through the Economic Research Service (ERS) issues reports on the Food Availability Data System, which include the "loss-Adjusted Food Availability data series for adjustment of national estimates of non-edible food parts and food losses" (USDA-ERS, 2009). From the 195 million tons (430 billion lbs.) of food available for consumption in the U.S in 2010, the ERS calculated that 31% was not eaten. With the world's population increasing and demanding greater resource consumption, the pressure on agriculture leads to increasing food waste. The U.S. wasted the equivalent of more than 121 billion euro (161.6 billion USD), based on 2010 retail prices.

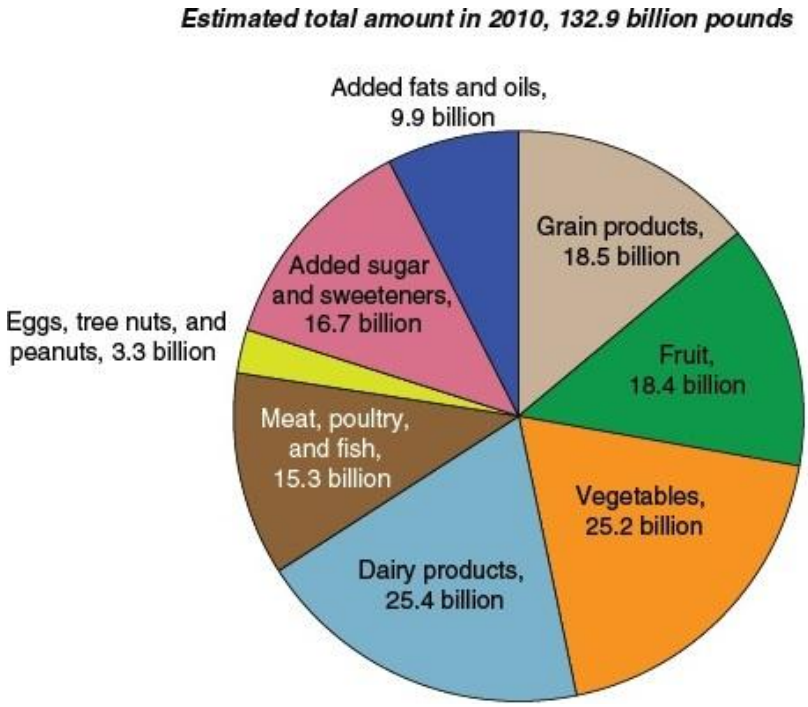


Figure 2.16: Distribution of the major food products estimated to represent31% of food loss of all food available for consumption in the U.S. in 2010. Source: (EPA, 2013).

Consumer and retail food losses are described in Figure 2.16, which reveals that dairy products and vegetables represent more than 25% of losses, with grain products, fruit, added sugar and sweeteners, meat, poultry and fish between 15 and 20%. The last category actually represents the largest share based on value followed by vegetables, dairy products and fruit (see Gunders's report from 2012).

Reports for consumer losses are based on spoilage, cooking shrinkage and plate waste, and except for added fats and oils, consumer levels of food loss are always larger than retail (see Table 2.4). This reflects the food habits of the American people: purchasing, storing, processing and discarding food. Also to be noted is the economic value ascribed to each loss featured in Figure 2.18 (EPA, 2013).

American habits in regard to food production consume 25% of the country's fresh water, causing unnecessary chemical usage for agriculture due to the fact that 40% of the food in the US goes uneaten. Food discards settle in landfills, which are responsible for 25% of US methane emissions. The waste effect is bounded with high consumption of natural resources for feeding stock and farming practices, such activities create important environmental impacts, raising the need for sustainable practices.

Nutrition in the U.S. is also an issue that needs addressing, as plates and kitchens are overfilled with products purchased in bulk quantities and varieties. "In America, the actual food waste is 50% higher than in the 1970s, being the average American consumer waste 10 times higher than someone in Southeast Asia" (Gunders, 2012, p.4).

Actions in Europe have been taken in order to understand the problem and identify solutions for food waste, and how much benefit can be obtained from it. The European Community in 2012 set in place a resolution to reduce food waste by 50% by 2020 and has been promoting 2014 as the "European year against food waste". This main directive reflects the efforts by member states in this area, for example, the United Kingdom (UK) launching a public campaign called "Love Food Hate Waste" designed to raise public awareness and encourage food retailers and producers to re-think their policies. Over a 5-year period the UK reduced 18% of its household food waste.

Table 2.4: U.S. food losses vary across food groups for 2010.

U.S. food losses vary across food groups

		Losses from food supply			
Food group	Food supply[a]	Retail level		Consumer level	
	Billion pounds	*Billion pounds*	*Percent*	*Billion pounds*	*Percent*
Grain products	60.4	7.2	12	11.3	19
Fruit	64.3	6.0	9	12.5	19
Fresh	37.6	4.4	12	9.5	25
Processed	26.7	1.6	6	2.9	11
Vegetables	83.9	7.0	8	18.2	22
Fresh	53.5	5.2	10	12.8	24
Processed	30.4	1.8	6	5.3	18
Dairy products	83.0	9.3	11	16.2	20
Fluid milk	53.8	6.5	12	10.5	20
Other dairy products	29.1	2.8	10	5.7	19
Meat, poultry, and fish	58.4	2.7	5	12.7	22
Meat	31.6	1.4	4	7.2	23
Poultry	22.0	0.9	4	3.9	18
Fish and seafood	4.8	0.4	8	1.5	31
Eggs	9.8	0.7	7	2.1	21
Tree nuts and peanuts	3.5	0.2	6	0.3	9
Added sugar and sweeteners	40.8	4.5	11	12.3	30
Added fats and oils	26.0	5.4	21	4.5	17
Total	430.0	43.0	10	89.9	21

Note: Categories do not sum to totals due to rounding.
[a]Food supply at the retail level, which is the foundation for the retail- and consumer-level loss stages.
Source: USDA, Economic Research Service, 2010 ERS Loss-Adjusted Food Availability data as of Sept. 17, 2012, and the U.S. population on July 1, 2010 (309.75 million).

Source: EPA, 2013.

Recommendations are already on the table, urging the American government to support more research about food losses and establish targets for food waste reduction. There still exists a global misinterpretation of food labels which has serious consequences in terms of food discards; if this was changed it is estimated that household food discards could be reduced by 20%.

Education is seen as a crucial vector for getting the public to understand the whole process and place value on the food chain. Programs should be promoted by the state and local governments. When people understand and have knowledge about good practices for handling food, it can help in reducing the amount of food waste on landfills.

Portraying the regular food supply chain used in four different countries, which are using the same basic products (see Figure 2.17), food consumed is confronted with food lost, transmitting an overall impression of current practices in regards to food disposal.

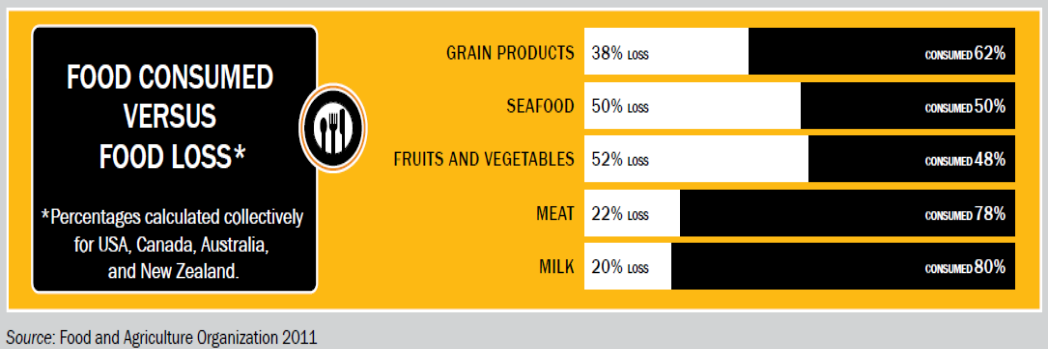


Figure 2.17: Food consumed versus food loss (as cited in Gunders, 2012).

It is known for the four countries above that, grain products have an overall loss of 38% and occupy enormous areas of agricultural land; moreover, the technique of monoculture exhausts the soil. The scandalous 50% losses of seafood contribute to the exhaustion of fish stocks and endanger their biological recovery. Implemented fishing policies and international agreements are also responsible for these high amounts, through the way they target species, sizes and seasons for consumption. Catches and discards are mostly driven by political and economic interests, where by country leaders try to find a fair compromise between catch size and sustainability of juveniles and species in general. The fishing technology used causes serious damage to fish stocks and the seabed. This is where scientists, politicians and managers of fishing companies need to work together in order to manage resources to guarantee the sustainability of the species. It is imperative to reduce the amount of fish discards and adopt good practices in order to prevent the destruction of habitats.

The international organization FAO provides updated studies covering the world's marine fisheries and issues technical papers on a fishery-by-fishery basis, and also current models capable of estimating discards by weight. Kelleher (2005) reported an evident reduction in discards through the analysis of the use of more adequate fishing techniques such as selective gear, increased utilization of catches and improved regulation. Also the use of low-value catches has gained a better position in the market, being used for human and animal food products.

International fishery management agencies voiced concerns about sustainability, policy issues and regulations, and the need for adaptation to current circumstances. Currently the NOAA lists Atlantic blue fin tuna (Thunnus thynnus) as a "species of concern", and despite the IUCN listing it as an endangered species (Amorim et al., 2011), in the U.S. Atlantic blue fin tuna is not considered endangered under the Endangered Species Act (2013). In 2011 the American Federal agency NOAA has committed to reviewing its decision by 2013, seeking improvements to Atlantic blue fin tuna Amendment 7, and management for sustainability. Such commitment aims to reduce discards and contribute to measures for compliance with international quotas, and managers, scientists, fishermen and environmentalists were invited to express public comments on the new proposal (NOAA, 2013).

Fruit and vegetables also suffer losses of over 50%, take up extensive areas of land and require a large amount of water resources for production. Harvesting techniques and handling represent an important stage in the food supply chain, but apparently they are not effective enough as the majority of losses happen at the end of the chain. Consumers have become very demanding for 'shiny' perfectly formed products, which are always on display when making a purchase. Leftovers from modern consumers, if we can call them that, are discarded after sitting on shelves and becoming overripe.

Milk and meat products are quite well consumed (80% and 78%) showing around 20% loss, being less latent then the previous food products. The fact might serve food habits and demand better control and delivery.

Based on a series of chart analyses on food losses in North America, Figure 2.18 shows the majority of losses along the food supply chain.

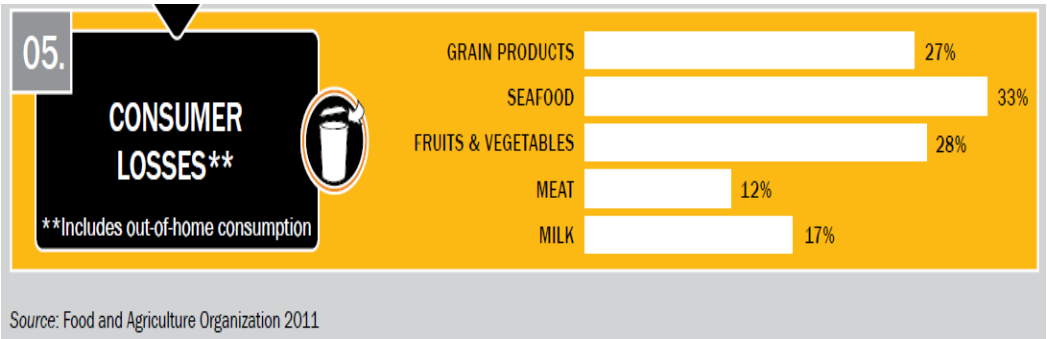


Figure 2.18: North American food losses. Food and Agriculture Organization 2011 (as cited in Gunders, 2012)

Issues are related to the huge availability of products and their variety in the market, which stimulate consumers' behaviour for consumption. Losses can also represent a misunderstanding regarding product handling, exposing items to thermal abuse and cause them to rot and become unfit for consumption. The size of portions and variety served away from the home can also explain the increase of discards, as shown in Table 2.2. It is estimated that 25% of food and beverages are discarded by American families. In the UK there are problems related to food spoiling through not being consumed quickly enough. Food waste in the UK accounts for two thirds of household waste, with the other third caused by oversized portions or cooking more food than is necessary. In the United States, the numbers are not known but evidence suggests:

- ***Lack of awareness and undervaluing of foods*** due to food available at cheap prices, consumers not placing enough importance on consumption and too much food ending up in the bin– even with environment- and cost-conscious consumers.
- ***Label dates confusion*** as consumers are not well informed about how to properly read and understand them. In the U.S. labels are not well regulated and do not indicate food safety;
- ***Spoilage*** due to low standards when storing food items, which are stacked in refrigerators leaving opportunity for cross-contamination between raw food, partially used ingredients and cooked food;
- ***Impulse and bulk purchases*** are driven by publicity in local store campaigns for consumption of unusual products or portion sizes. In many

cases they exceed the need for regular consumption and becomes discarded afterwards;

- ***Poor planning for meal preparation*** is a typical example of not using a shopping list and purchasing unnecessary products. Products end up being stored at home, becoming spoiled and then discarded.
- ***Meal over-preparation*** has increased over the last few decades, generating bigger portions richer in calories, which increases the chance of health problems.

"For the average U.S. household of four, food waste translates into an estimated 1,350 to 2,275 USD in annual losses" USDA (cited in Gunders, 2012, p.12).

The use of controlled landfills in the U.S. accounts for 23% of all methane production. From food waste, only 3% is processed as compost and food discards have become the major component of landfills; the food chain alone is responsible for 20% of the waste entering landfills. Composting can be a viable option as it reduces gas emissions and lixiviates produced from the decomposition process, which require specific treatment before being released into the environment. Also, nutrients can be recycled and used for agriculture.

Educating consumers about solid waste management and how important it is can become part of the solution by reducing impacts on the environment and also creating economic benefits. The decomposition process of food discards always releases methane. However, in controlled landfills methane can be used to produce an alternative source of energy, which is commonly used for as fuel for various machines or generators for operational pumps, electricity or similar. This has the effect of either making the facility self-sufficient in regards to fuel or just reducing its power costs. Due to the high amounts of humidity this causes, the gas might not be suitable for use as an alternative fuel, in which case it is flared.

"The notion is that the food is not recycled to create compost or energy but used for the original purpose for which it was produced, i.e. human consumption" (Schneider, 2013, p.755).

2.3. Indicators of sustainable development for fieldwork research

The use of indicators for development management has been in practice since 1950 through the international conferences promoted by the United Nations (UN) with economic indicators for modernization (Hartmuth, 1998). An indicator can be described as a tool for management or naturally to understand the state, level or condition of a certain “object” in the study. Indicators are signs that provide information about specific happenings or events which can be noticed and quantified by them. The question that arises is why we need such indicators, and what “is the need to implement a system of indicators” (Frausto, Giese & Chale, 2002).

Indicators of sustainability can serve the purpose of measuring and assessing conditions for development, and also setting sustainable limits. In many cases it is difficult to define limits as we are living in a fast-changing society, requiring a tremendous consumption of resources and waste disposal. For example, limits for natural resources and living species are important to measure, which can be accomplished using the Ecological Footprint, the Environmental Sustainability Index (ESI), and the Environmental Performance Index (EPI). Such instruments translate human resource consumption and waste generation in a country or any other entity into a measure of biologically productive land and water, and relates it to a measure of biological capacity. The ESI tracks natural resource endowments, past and present pollution levels, environmental management efforts and the capacity of a society to improve its environmental performance. The EPI aggregates indicators related to resource depletion, pollution, environmental impact and energy efficiency into an index aimed at measuring policy impact (Emerson, Hsu & Levy, 2012, p.42).

There is currently a strong relationship between the use of indicators for strategy and governance, and sometimes just the simple fact of portraying physical and social knowledge. Values can be exchanged among foreign communities or nations to assist in managing policies, or used as a guide for measuring progress towards sustainable development.

During the Earth Summit in Rio (1992), world leaders agreed to join forces to develop indicators to measure sustainability. Prompted by the Brundtland Report (UN, 1987) and based on Agenda 21 (1996), the first set of 134 indicators (1996 – 1999) was tested in 22 countries and presented through

training workshops and regional meetings. Due to some complexity at institutional level and the need for adequate human resources, there was an evaluation and revision of the initial set in 2001, later reduced to 58 revised indicators and accommodated in flexible themes and sub-themes.

Following guidance and the indicators system from the Commission for Sustainable Development (CSD), many countries implemented their own indicators, adapting the tool for local needs and looking for more effective and accurate solutions. Sustainable development indicators were set to measure progress and included in the United Nations Millennium Declaration in 2000. Countries became eager to comply with international commitments, working along with experts and crucial methodology to assist on achieving the Millennium Development Goals (MDGs).

The World Summit on Sustainable Development held in Johannesburg in 2002 and the Mauritius Conference for reviewing the Barbados Program of Action for the Sustainable Development of Small Island Developing States (SIDS) in 2005, designated the period 2005-2014 as the United Nations Decade of Education for Sustainable Development (UN, 2013). Twenty years after the Rio Earth Summit the international community created clear measures for implementing sustainable development through the use of green economies and lifting people out of poverty (UNCSD, 2012). Based on the Millennium Goals a new set of critical issues (jobs, energy, cities, food, water, oceans and disasters) became new targets for the 2015 development agenda.

As a strategy to eradicate extreme poverty and hunger, the World Tourism Organization set in place the Sustainable Tourism – Eliminating Poverty program (UNWTO -ST-EP). Countries like Mexico are participating in adopting the system of indicators for sustainable development, contributing with 134 indicators, designed and clustered by themes as described in Agenda 21 and divided into 4 categories – social, economic, environment and institutional. Leaders are much more interested in implementing the indicators and complying with international commitments than only seeking solutions to monitor or control issues arising from the 4 categories (Frausto, Rojas, & Santos, 2006).

At the Caribbean and Central America International Congress for Indicators for Tourism Development, Frausto and Chale (2003) identified a list of 54 indicators for Cozumel Island, highlighting “Environmental Education” as the

indicator claiming high priority to achieve balance and guarantee sustainability for future generations.

During fieldwork for the current thesis, the case study of Cozumel Island became a model for managing protected areas and tourism destinations looking for sustainable development policies. The indicator was developed for Cozumel Island reinforcing the need for educating people and becoming more responsible and capable to respond to local environmental issues. On this particular island, the key indicator was implemented through an educational course covering environmental issues and contributing to the indicator called “Environmental Education for Tourism Providers” described by Frausto and Chale (2003) as mandatory for any professional who needs to access the Cozumel Reef National Park (PNAC, in Spanish).

Taught since 1997, the environmental education course has been a blue print for qualifying diving instructors, diving and snorkelling guides, boat captains and their crew members to work inside the marine park.

As mentors of the program, Garcia and Dominguez (1999) covered subjects like “Physical-geographical aspects, Terrestrial ecosystems, Coral reef ecosystem, Zoning, Natural enemies of coral, Man and the coral reef system, Cozumel coral reef, looking and touching, purposes and goals of the PNAC and laws governing the Natural Protected Area” (Frausto & Chale, 2003, p 56).

According Frausto and the PNAC (2003), during the first segment of the course (5 years) more than 1500 participants attended the educational program on Cozumel. The evolution of the environmental education course generated a recent database for analysis, identifying socio-demographic variables since 2008, and providing abundant information to suggest improvements to the training course.

As already mentioned by Frausto and Chale (2003), the course is still active but there is no track of participants after attending the training program. There is enough information to describe the indicator, but in some cases there is insufficient data for analysis of tendency, spelling failure for the strategy for assisting to predict problems, risk and significant changes in the PNAC.

Since 2007, the PNAC has promoted the restructured training course, developed by the Coral Reef Alliance, which covers environmental issues and contributes to the indicator described above. This falls in line with the priority to raise awareness and change attitudes towards the environment.

The study case of indicators for sustainable development on Cozumel Island became a scientific article reporting an update to the representative database, going up to the last course taught in2012 (Environmental education for tourism providers and volunteers in Marine Protected Areas: The case of the Cozumel Reef National Park - on peer review). The document has a list of suggestions for improving the efficiency of the course, aims to verify issues for data quality, evidence participation in the course by tourism providers and volunteers, and identifies best practices for the ecosystem.

The aim of this research is to use nature-based activities to educate tourists regarding good environmental practices. The Cozumel environmental indicator plays a very important role in the research as it prepares professional staff for educating, assisting and guiding diving tourists in the PNAC. Role models can make all the difference and be crucial for the success of the investigation when participants are permanently exposed to an alien environment and can observe first-hand the impacts created from anthropogenic activities.

2.4. Study area: Cozumel Island and scuba diving activity

For a number of decades, Mexico has been developing economic activities that have produced impacts on the existing natural resources. Their resources have been used in a certain way to limit the decreasing capacity for regeneration called non-sustainable use (Chavez, 2005). High levels of contamination were recorded, which became a growing concern for authorities and programs were implemented to minimize the impacts by developing the country in a more sustainable way. The Mexican Tourism Board transposed its Agenda 21 commitment for the travel and tourism industry (SECTUR, 2003), enforcing tourism development to conform with environmental sustainability in order to deliver economic and social benefit to communities.

Cozumel is located on the Mesoamerican Barrier Reef system and is the largest island in Mexico. In July 1996, the southwest part of the island was declared the Cozumel Reef Marine Park and in 2002 it achieved the status of National Park. The park lies east off the mainland at 20° 29’ 02.93” and 20° 14’

27.02” N; 86° 53’ 11.54” and 87° 03’ 32.07” W, covering 11 987 ha from the high tide shoreline to 2.5 nautical miles offshore (PNAC, 2013).

Figure 2.19: Cozumel Island in Yucatan peninsula. Source: http://www.lasventanascozumel.com

Cozumel Island can be accessed by car/passenger ferry boat with a 16.5 km journey from Punta Venado near Playa del Carmen. Cozumel International Airport can support up to 9 flights an hour and the smaller Capitan Eduardo Toledo airfield caters for small and private aircrafts. Cozumel has three international piers for international cruise liners and receives around 2.5 million passengers per year (SEDETUR, 2012).

According to the Secretary of Tourism for the State of Quinta Roo, visitors filled 51% of hotel occupancy among the 45 hotels on the island; 4,098 rooms accommodated 403,793 tourists. The average stay on Cozumel, in the same year was 3.3 days and tourists spent an average of 538.00 USD during their visit. In 2012 according to the Port Authority of the state of Quintana Roo (APIQROO, 2012), 2,744,952 passengers visited the island by cruise ship and spent an average of 89.00 USD during their 7–11-hour stay. Connections to the mainland carried 1,343,718 passengers by ferry boat and 457,269 by plane (ASUR, SEDETUR, 2012)

Cozumel Island is populated by 79,535 habitants (INEGI, 2010) who rely heavily on the tourism industry. A profile study conducted by Jiménez, Jiménez and Hernández (2005, p. 56), found that 41% of the people visiting Cozumel were interested in water activities, of whom 75% went on scuba diving or snorkelling excursions. Following this trend, Santander and Propin (2009) confirmed the strong dependence on water activities by the island, finding more than 23 diving spots.

The water temperature on Cozumel Island ranges from 25 to 29 °C, depending on the season and also on the current flowing on the channel. Cozumel is known as the capital of drift diving on the Caribbean Sea; the water flow is mainly conditioned by the North Equatorial Current, and an extension of South Equatorial Current, the Guyana Current. In the Antilles, the current splits

into the Caribbean Current, and crosses the Yucatan Strait to form important gyres in the Gulf of Mexico.

The Caribbean Current flows at around 26 to 34 million m^3/s, increasing its speed when crossing the Yucatan Channel (Gordon, 1967). On both sides of the current there are back flows and important gyres with variable speeds. However, the main current flows over the east point of “Mosquito bank” and over “”Rosalinda bank”, is on the Yucatan Channel where the Caribbean Sea connects with the Gulf of Mexico, flowing at 3–4 knots and reaching it speak at 180 m deep (Emilsson, 1971). Affecting directly the local reef, and situated closer to Cozumel Island, the dominant current flows south–north at 1–3 knots in the channel between Cozumel and the mainland depending on the season.

A multitude of tropical fish can be found on the Cozumel Reef; depending on the season, species like eagle rays can be seen as well as sea turtles, black and white tip reef sharks, nurse sharks, tuna fish, marlins, manta rays and whale sharks. The southern tip, Maracaibo, has a 45 m deep wall, which delights drift divers swimming along the fissures; dramatic coral formations; and offers an amazing view of the magnificent arch and overhangs. Large pelagic fish can be seen at this point and only very experienced divers are recommended to dive the Maracaibo wall (see Figure 2.20 for Cozumel dive sites). Another popular reef is the Santa Rosa wall, which offers huge coral formations and a variety of fish feeding on the long edge of the wall. Sharks, rays, moray eels and turtles are often seen here. In town, everybody praises Colombia reef for the variety of expertise levels required for diving at the spot. Many swim through can be found here, and sometimes divers can look down into the abyss at the 37 m deep wall.

Perhaps one of the most crowded and visited dive sites is Paradise reef, which is an entry-level reef but also a ‘must dive’. At Paradise, coral formations are found 12 m down, which is ideal for beginners as it keeps them with the depth limits suggested by the training agencies. The reef sits on a slope full of giant sponges and has some wide sandy areas for practicing diving skills during training courses. Also the species found on the reef vary from turtles, rays, cleaner shrimps, colourful anemones, crabs and the famous toadfish. Here all kinds of marine life can be observed. At the site it is possible to find more than 100 divers underwater at the same time. The impact created on the reefs has become notorious at the overcrowded the dive sites due to a lack of good practices and diving skills. Underwater, marine life should not be touched; divers

must control their buoyancy permanently and never stirring the bottom as sand can clog the corals, which is an external stress factor.

Figure: 2.20: The reefs of Cozumel.

The PNAC (2013) estimates that 1500 visitors, among them divers and snorkelers, visit the local reef areas daily and the park uses the same number as the field capacity of Cozumel reef. The value is estimated from a function of seats per diving embarkation which have been registered with the Port Authority to operate in the marine park. The park controls the divers' entry through the wristbands purchased in the main office. In 2012 the National Commission for Protection of Natural Areas in Mexico (CONANP) issued a total number of 299,395 wristbands. Considering that not every boat went out at full capacity, for 2012 the average number of divers in the water was 818 per day.

Cozumel Island is a very popular diving destination and a multitude of diving courses are offered there to allow visitors to enjoy the local reefs. According to PADI (2013) the State of Quinta Roo receives the highest share of the diving industry revenue in Mexico. Figure 2.21 illustrates the annual distribution of diving certification in the country, revealing that in terms of dive experience (Dive Experience) courses for non-divers lead according to the PADI figures, followed by entry-level courses (Entry level) for tourists who sign up for scuba-diver or open-water-diver courses. The high number of try dives is the result of good marketing of Mexican reefs and also derived from the cruise arrivals to certain ports of call like Cozumel Island, Calica and Costa Maya on the Caribbean side.

Certified divers are also represented in the figure through taking further-education diving courses (ConEd Core), or specialty courses (ConEd Specialties) offered by the training agency, but these represent only around 300 courses per month or less. The lower rank on the table refers to the very important non-diving course for emergency first response, required for rescue divers and those at professional level.

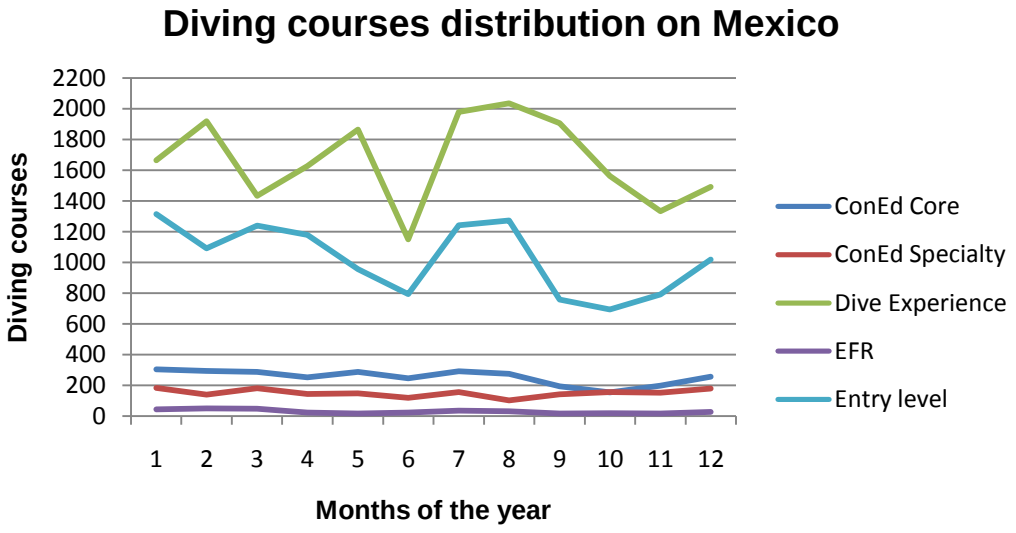


Figure 2.21: Annual diving course distribution for 2012 in Mexico, used with express permission of PADI (2013).

It is clear that the peak season for scuba diving runs is July and August, and then decreases substantially until the end of December. The New Year period shows few entry-level certifications, but there is a sharp increase in try-dive experiences, probably generated by passengers traveling on a cruise during the first two months of the year. April and May brings in the young American generation for Spring Break in Mexico. Diving courses for further education are quite regular throughout the year and represent a different segment in the market.

The closest picture we have of the Cozumel diving scene is represented by the breakdown of diving certifications awarded in 2012, provided by PADI (2013).

Figure 2.22 shows a clear image of the diving business, representing the grand total of courses taught in Mexico and also in Quintana Roo (6). The most popular levels are again day diving experiences (3) for non-divers, followed by entry-level courses (5) on the Caribbean Sea, which are definitely derived from the cruise liners arriving at the ports of Cozumel, Calica and Costa Maya.

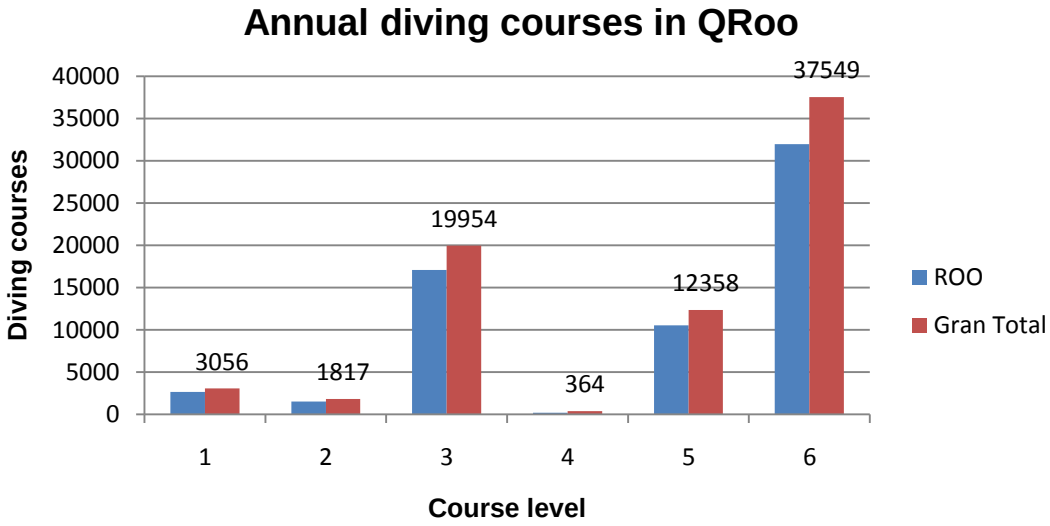


Figure 2.22: Diving course distribution for 2012 in Quintana Roo State. 1 – Continuing education core; 2 – Continue education specialties; 3 – Dive experience; 4 – Emergency first response – EFR; 5 – Entry level; 6 - Grand total, used with express permission of PADI (2013).

On the east cost of the Yucatan Peninsula, scuba diving takes place around Holbox, Isla Mujeres, Puerto Morelos, Cozumel, Playa del Carmen,

Tulum, Mahajual and Banco Chinchorro, a coral reef located offshore. Also diving the cenotes has become a big attraction for the enormous fresh-water cave diving system, where requirements are much stricter and a diving certification is always a prerequisite.

Along the coast the model used for tourism development has seen large hotels built, which are owned by international groups being so exclusive but offering a wide range of tourism products, including day excursions to Cozumel Island and scuba diving activities on local reefs (Cordoba & Garcia, 2003; Manuel-Navarrete, 2012). Cancun has only 17 km of coast crammed with hotels on the beach front, cutting access to the beach.

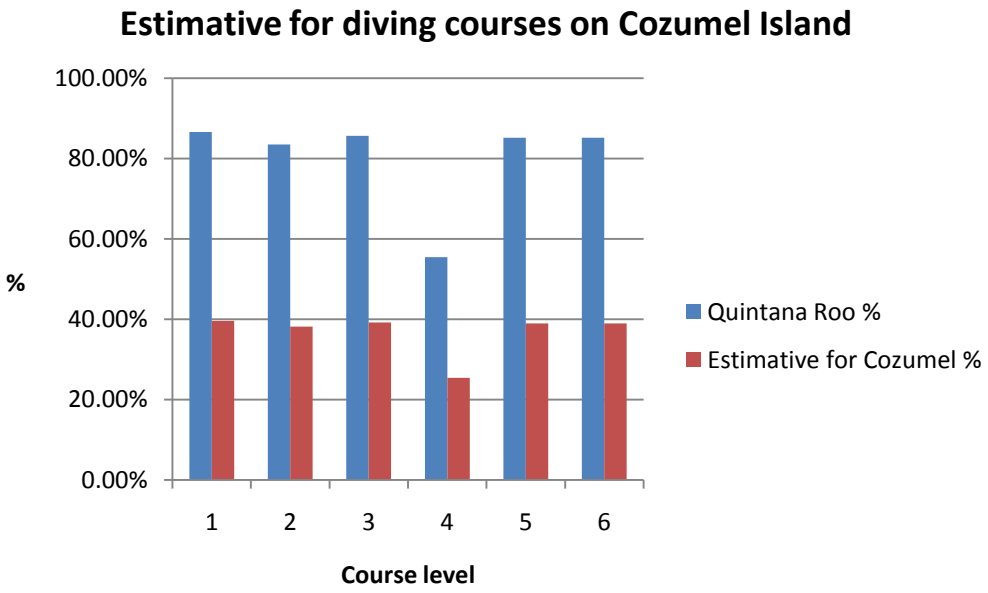


Figure 2.23: Annual percentage of diving courses taught in Quinta Roo in 2012. 1 – Continuing education core; 2 –Continuing education specialties; 3 – Dive experience; 4 – Emergency first response – EFR; 5 – Entry level; 6 Grand total, used with express permission of PADI (2013).

Cozumel Island makes a strong contribution to diving education on the Caribbean Sea; however, data available refer to the entire state of QRoo. A search of the PADI website showed dive schools listed for the main tourism areas, and those most representative for scuba diving. For example, the Cancun area together with Isla Mujeres has eleven diving schools, and Playa del

Carmen, the well-developed tourist location, hosts twenty one diving schools. At the time of the research, Cozumel alone had twenty seven registered PADI diving schools, but considering a proportional division among the three major tourism areas, Cancun, Playa del Carmen and Cozumel Island, the Figure 2.23 offers a rough estimate of how much Cozumel Island contributes to the diving business and how much it is represented in the state of QRoo.

From the estimated values for Cozumel Island it is clear that the magnificent reef attracts approximately 39% of the total diving programs in Mexico. The island receives millions of tourist every year, arriving by cruise ship, ferry boat or aircraft. Table 2.5 lists the top ten nationalities taking a diving education course on Cozumel Island. According to PADI (2013) the countries they come from remain pretty much consistent year to year, and do not include the discover scuba diving experience or the emergency first response course.

Table 2.5: Top 10 divers by nationality in Mexico.

2012 Cozumel Top 10	
1	United States
2	Mexico
3	Canada
4	England
5	France
6	Germany
7	Spain
8	Argentina
9	Netherlands
10	Switzerland

Note: Used with express permission of PADI (2013).

For good management of the natural resources found on the island, the local government and the Tourism Academic Board proposed a list of sustainable indicators for the region. The objective was to define and measure sustainable development according to the objectives (Frausto et al., 2002). The use of indicators supports data for the study presented and furthermore provides an extra educational briefing to all divers visiting the Marine Park and offers an alternative educational experience. When divers engage in the activity, they are always accompanied by a dive guide or a diving instructor. Their mission is to

safely escort divers along the reef, to help them observe the coral formations on the area and to indicate the most interesting species dwelling on the reef. Dive professionals and boat staff are so well educated on environmental awareness that they always include in their briefing the most suitable route along the reef, and outlining acceptable diving procedures on Cozumel Island. All of this is educational and is an add-on to the training programs due to the fact that divers socialize on the boat and observe the behaviour of local staff and customers.

2.5. Summary and discussion of Chapter 2

Without doubt the Millennium Development Goals raised awareness of many global issues. Regarding environmental aspects, already in 1972 in world forums leaders were willing to adapt to a new reality and rethink economic development policies for better sustainable development, which was highlighted in the Brundtland Report (UN, 1987). The report became the basis for an extensive set of guidelines that fulfilled economic needs without compromising the legacy for coming generations, as they too will have the right and need to develop according to their own requirements listed in Agenda 21.

In 2000, the leaders of 147 countries represented at the Millennium Summit (New York) expressed the commitment of each member state to a series of targets for the period 2000–2015. During this timeframe each country would carry the responsibility to develop programs to reduce poverty, respect human rights and demonstrate good will in achieving the targets known as the Millennium Development Goals (MDGs). This motivated countries to follow suggestions from the United Nations, which provided guidelines for setting up local indicators for sustainable development.

For a better understanding of this research, the environmental indicator will be examined in detail, highlighting the seven MDGs aiming to “ensure environmental sustainability”. Targets for meeting the goals were set and aimed at tackling issues like deforestation around the world, which some countries in Africa, Oceania and South America which are struggling to control. Huge fires have consumed green areas, destroying natural habitats important for sustaining life in the process. The fires also strongly affect local air quality, causing

temporary health problems, and contribute to gas emissions. Burned soil increases the runoff of rainfall, which carries away dissolved inorganic nutrients and suspended particles, which eventually end up being deposited in lakes, streams and rivers, reducing water quality. Also fires contribute to aesthetic changes in the landscape.

The 57 developed regions produce more gas emissions per capita (11 metric tons of CO_2) than the remaining 161 developing countries (3 metric tons of CO_2), due to their higher population density. However, overall gas emissions are higher in developing countries, perhaps because of the industrial boom during the last decade facilitated by distinct environmental laws compared to developed areas. This forced world leaders to develop legal instruments to assist in controlling climate change.

Also protected areas have been increasing around the world, as an attempt to conserve natural habitats and practices for resource management. Marine protected areas have increased substantially compared to land protected areas, but fish stock have declined abruptly, in some cases reported to have fallen below biological limits of sustainability (MDGs, 2012).

Targets to help achieve MDGs were set and some have been reached ahead of time, for example, according to the United Nations Bureau (2013), half of the world's population now has access to safe drinking water. However, some other targets are proving difficult to reach. Data show a tendency for the number of people living in slums to decrease, but the fact is that the number of slum dwellers continues to grow due to urbanization at such an elevated pace (MDGs, 2012; 2013). The efficiency of such goals that were set in order to comply with the MDGs has come under the spotlight. There is currently a discussion about the new framework for the MDGs for the post-2015 period. Manning (2009) proposed discussions about possible approaches for the MDGs 2.0, indicating incongruent targets that deserve to be remodelled to make them more realistic and appropriate. Organized groups are working on proposals, indicating essential "must haves" in the new framework; the "Group of 77" will not accept another UN- or expert-led process, alleging that "Northern countries" do not bring the South any further, as South-to-South efforts bring more benefits to developing countries.

As part of the United Nations Development Program (UNDP), the executing agency World Tourism Organization carries out technical co-operation

with governments, helping them to implement indicators based on Agenda 21. The organizations take part in the Sustainable Tourism – Eliminating Poverty (ST-EP) program, addressing issues to be solved through tourism programs and local development (UNWTO, 2013). When a natural catastrophe occurs, the WTO coordinates programs to assist countries by offering technical and financial aid, aimed at rescuing local economies through the development of marketing campaigns to boost confidence in and the reliability of the tourism market. Retraining programs are implemented to serve local needs for tourism, usually empowering women and targeting the young generation.

Tourism represented 9% of global GDP in 2012 (UNWTO Tourism Highlights, 2013) and is responsible for millions of jobs worldwide. The tourism phenomenon is a multidisciplinary industry, involving all types of services necessary for tourism activity. Tourism alone is responsible for 235 million jobs and is the fourth largest export sector in the world after fuel, chemicals and automotive products. Since 1980 and for the first time, there were over 1 million international tourism arrivals in a single year – 2012 (UNWTO, 2013). Traveling has become a social norm and is necessary for cultural interchange and executing business strategies. Already during the 17th and 18th centuries travelling had become important for gaining knowledge and learning about different cultures. Wealthy individuals would engage in traveling for several years to be exposed to new experiences and foreign civilizations.

The learning process was already important back then for human development as an educational tourism experience. In modern times, Ritchie (2003) described the motivation for traveling as “tourism first” and elsewhere during the trip an educational/learning experience takes place. The educational motivation is also described as “education first” for travellers more interested in engaging in educational programs, usually while abroad, and also demonstrating some motivation for traveling. Benefitting from these two motivations, educational programs are set for hosting learners, while guide them through official curriculums or informal experiences contributing to their learning process. Educational tourism has become a billion-dollar industry ranging from official school curriculums, language programs, internships, volunteering or professional practice ships, to edutourism. This latter, which describes educational tourism, is driven by a need of intellectual stimulation during recreational traveling. Learning can take place in natural environment (Gonzales, 1996) transferring knowledge

through experience (Falk et al., 2011), or can be an informal experience when visiting museums, zoos, science centres, etc. (Falk, 2005).

The learning process described in this thesis refers to experience and learning through a nature-based activity (scuba diving), which is meant to act as a tool for reducing marine debris by educating people about the marine environment, specially raising awareness among divers. Simply experiencing such activities and observing marine debris on the reef first-hand is enough for some people to become sensitive to the issue and adopt more responsible behaviour in their household, from having learned that marine debris also originates on land due to poor waste management procedures.

David Kolb's (1984) theory provided the basis for designing the research model proposed in this thesis, and also describes individual differences for learning when the experiential process takes over. The comprehensive theory uses life-long experience to define what learning style divers prefer. The concrete experience of diving will generate observations from marine life behaviours, after which divers can reflect on what they have seen or felt, and on what influenced their enjoyment of the experience. Cognitive activation will assist in forming abstract concepts about a certain learned experience, and also generalise for testing concepts in a new situation. Kolb combined four learning styles (feeling, watching, thinking, and doing) and learners can enter the process at any stage based on their learning preference; furthermore, it is recommended to complete the entire learning process for it to be most effective.

Despite the theory being used in many school programs and by many researchers, it has garnered criticism (Gardner, 2000; Koob & Funk, 2002; Kayes, 2005) and some authors found it contained theoretical conflicts (Hunsaker & West, 1980; 1982). For instance Ferrel (1983) evaluated alternative learning models and compared them with the learning cycle and ultimately not being by any of them, and other authors suggested using Kolb's theory only for descriptive studies. Favourable opinions of the learning cycle were offered by Raschick, Maypole, and Day (1998), and Healey and Jenkins (2000) acknowledged using Kolb's theory on structuring courses due to its wide applicability.

Kolb's theory represents the experiential learning process to which divers are exposed along this research, which aims to study divers' behaviour in their household regarding plastic and food disposals. In this research, behavioural

studies follow the TPB. Initially presented through the TRA, Fishbein and Ajzen (1975, 1980) measured the relationship between intention and attitude regarding a certain behaviour; however, Ajzen (1985) concluded that behavioural intention alone could not represent the behaviour in a study. Attitudes can lead to behaviour and are widely accepted as explaining behaviour; although it cannot be measured directly as it requires an observed behaviour and consistency throughout the process. During fieldwork, divers were assessed before and after exposure to the water; having the sea as a stimulus response, interpretation can mediate plastic consumption and management practices. Positive responses will eventually lead to positive behaviours in their household.

Important for the base theory are beliefs, which represent specific information and also link objects to attributes, for example, the belief of “using a shopping list” (the object) to “reduce food waste” (the attribute). Also the base of the theory describes behaviour and attitude influencing the development of new beliefs, leading to attitudes toward the behaviour and eventually to a final behaviour. Beliefs can be generated through direct observation of “fish mistaking plastic for food” supporting descriptive beliefs about plastic, or non-direct observations like those provided by people, television, books, magazines, etc. which are classified as informative beliefs. Another important belief is the normative belief that society or a group of referents think how we should perform. The totality of all normative pressures leads to normative norm.

According to TRA, attitude and subjective norms are strict precedents for intention to perform behaviour. Ajzen (1985) included a new variable in his model to help predict behaviour, as the intention to perform a certain behaviour should be controlled in order to overcome situations that might interfere with behavioural performance. People perceiving the ability to perform a given behaviour, and who are in control, respond to the new variable of “Perceived Behaviour Control” (PBC). The TPB is an extension to the TRA model, containing the foundation of the previous theory, including general attitudes toward physical attitudes and attitudes toward performing a particular behaviour (Ajzen, 1991, 2012).

Behaviours for using good practices of waste management will be measured in the divers’ household where municipal solid waste is regularly generated. The OECD released the latest report that revealed an average production of 540 kg of msw per capita in 2010. During fieldwork, the target

population for study was the U.S., which was the annual leading producer in terms of msw per capita with 720 kg (OECD, 2013). Data listed by the Environmental Protection Agency showed that in the last available year (2011) for msw production, U.S. citizens produced a daily average of 1.99 kg of msw per capita, with plastic and food discards at the top. Only 8.3% of plastic and 3.9% of food waste was recycled. During 2014, an eco-fee of 5 cents will be charged in the U.S. for single-use plastic and paper bags at grocery and retail stores. The U.S. government wants to tackle the issue by encouraging the use of reusable bags and reducing littering.

Plastic polymers can be found in many different forms and have a strong presence in our daily lives. Plastics contain additives that can be either harmless or toxic, and are mostly derived from petrochemical compounds. It is estimated that they are present in 30% of single-use items worldwide (IMSA Amsterdam, 2011). In the U.S. there are recycling programs, which are widely implemented across the country, although the population must take active participation in waste management practices, in particular to those absorbing recyclable products. Studies conducted in 2013 mentioned the accessibility of 94% of the American population to PET and HDPE bottle and cup recycling, and 57% to all plastic bottles and non-bottle rigid containers, although the recycling rate is only 30%.

Plastics are the major component of marine debris and can originate on land (Hinojosa & Thiel, WSPA, 2009; 2012) or from activities at sea. For better management of landfill, biodegradable plastics are already being introduced into our lives as they are more environmentally friendly. They have a shorter degradation time, but need specific conditions such as certain species of microorganisms, humidity, ph, temperature and residual time for decomposing. Bioplastics can be produced from waste water, vegetable fat oils or starch, but will always be potential marine debris; plastics in water environments do not have the same decomposing rate as on landfills, leading to potential ingestion by marine animals or causing them to become entangled.

Food waste studies reported that the U.S. has a high usage of natural resources. 80% of their fresh water consumed, 50% of their land for farming, and transportation takes up10% of the U.S. energy budget. In the U.S. 31% of food is not eaten and is just discarded, generating large amounts of municipal solid waste. The ratio between food loss and what is actually eaten is absurd. For

instance 50% of seafood and also fruit and vegetables is discarded after having consumed so much water, energy, chemicals and hand labour while being processed. Consumer losses also reflect U.S. habits of purchasing, consumption and discards. The major losses take place at the end of the food supply chain, namely through consumers.

All the subjects touched upon above are important for sustaining the model presented in this thesis. Fieldwork research took place on Cozumel Island, Mexico where coral reefs thrive, but unfortunately are placed under a lot of pressure by tourism. A set of 54 indicators for sustainable development was developed by Frausto and Chale (2003), highlighting environmental education as the area requiring the most urgent attention. An environmental educational program for tourism providers and volunteers was developed by Garcia and Dominguez (1999) aiming to educate diving professionals, boat staff and any other professionals required to work inside the Cozumel Reef National Park. The course has contributed to reaching the indicators proposed by Frausto and Chale (2003), although they noted the urgent need to keep track of participants, collect crucial information for good management of the course, and develop a refresher course.

Chapter 3

3.1. Justification of the methodology

This chapter explains the methods applied for conducting the multidisciplinary research project, aiming to find answers for the objectives proposed on Chapter 1 (see section 1.2). The first key point in this investigation is pollution caused by “marine debris’, which has driven scientists to investigate its impacts, and motivated research on educational set ups for minimized debris. Already some good literature can be found (e.g., Coe & Rogers, 1996**;** GEF, 2012; WSPA, 2012) reporting actual data on the tremendous impacts on the ecosystem, and providing some suggestions for dealing with the issue. According to the field of expertise of each author, specific details are listed and not only cover the Great Gyres, but also the multitude of situations where life is being threatened and the current level of degradation on water bodies. Marine debris is endangering future generations and little attention is being given to the issue.

The second key point addresses the use of nature-based activities, for example scuba diving, as a way to raise awareness among people and educate tourists at diving destinations. Scuba diving is more than just being submerged in water to observe marine life; it is a way to educate people about resource management and personal responsibility in minimizing their ecological footprint. Responsibility must be carried every moment at home while going about our daily routine. Thoughts about reducing marine debris attempt to link the issue with observing marine debris first-hand and what potential impacts they carry for marine life and society in general.

As a diving instructor, I have spent thousands of hours in the open-water environment, and probably the same amount of time, or even more, dedicated to instruct people in scuba diving. As part of my duties, environmental awareness needed to be taught, and using the marine environment was crucial for educating students as they could observe environmental concepts approached during training sessions and appreciate how sensitive and beautiful the underwater world is. Here is where the issues connect and the whole scheme of investigation starts to develop into a research document aiming to be a future

reference for the environmental and social sciences, and also a good tool for natural resource management. As mentioned above, the interdisciplinary research aims to approach the serious problem of marine debris by encouraging a possible reduction of it at source. Apart from learning good and safe diving practices, students can learn basic environmental awareness and receive suggestions for responsible behaviour in this area.

Those wishing to engage in scuba diving regularly need to be able to afford it, as scuba gear is quite highly priced and diving with a diving operator carries additional costs. Divers tend to be quite wealthy (e.g., WTO, 2001; Grőssling et al., 2004; Vianna et al., 2010) with a minimum annual income of 35,000 USD, which allows them to travel to coastal areas. Studies revealed that divers are mostly male (Ditton & Baker, 1999; Mundet and Ribera, 2001; Musa, 2003; Todd, 2004; Tourism Queensland, 2006; Belknap, 2008), and all are willing to travel long distances to visit different reefs and observe certain attributes of the sea floor where biodiversity provides attractive conditions for flourishing scuba diving activity.

According to the literature divers' education level (Cater & Cater, 2001; Musa, 2003; Thailing & Ditton, 2003; Todd, 2004; Grőssling et al., 2004; Musa et al., 2006; Belknap, 2008; Ong & Musa, 2011) ranges from postgraduate studies to secondary school, which is important information for the study as it aims to contribute comparative data.

At this point, divers had already been linked to the problem of marine debris, and it was decided to select our target population based on data provided by reliable sources like the OECD, where some countries share information regarding municipal solid waste (msw) generation. According to the WSPA (2012), marine debris can originate on land or from marine-related activities; however, as participants in this study have the potential to generate waste (msw) on land, municipal solid waste will be the index to use. During analysis, the OECD list is populated with most of the countries located in the developed regions of the world, being those registering higher population densities. This fact needs to be taken into account as these societies also tend to generate more msw than those from developing areas.

Once the first index is noted, the population to study must be identified. In the last available report annual from the OECD (2013), the United States (U.S.) was cited as the country creating the most msw with an annual average of 720

kg per capita. Thus, the target population is U.S. divers, which is very convenient due to the compatibility with an international fellowship for fieldwork, offered by the Sustainable Development Division at Universidad of Quintana Roo, Cozumel (UQRoo) – Mexico.

References for municipal solid waste generated in the U.S. soil were gathered from the EPA, providing good statistic values, describing also the American scene quite well by listing quantities of msw generated including the percentage recycled per year. In the EPA's last available report (2013), only 8.3% of plastic and 3.9% of food waste was recovered as a percentage of total generation, representing a very large number in terms of major discards. After recycling and composting only a small percentage of the generated msw, 21.3% of food waste and 17.8% of plastic still represent the major discarded products (see Table 2.2 and Figure 2.14 in Chapter 2, section 2.2.1). The major argument behind the decision of which type of msw should be used for research is outlined in Table 2.2 and Figure 2.14, where discards are portrayed and targeted as potential marine debris. It is evident that we are talking about plastic and food discards as the reason for assessing the population of U.S. divers visiting Cozumel Island in Mexico.

The fieldwork location was also chosen due to convenience, as through the cross-border movement in Mexico, in 2012 could be counted 5,941,914 U.S. citizens visited the country (SIOM, 2013). It is a popular holiday destination for U.S. tourists. Cozumel Island offers great conditions for scuba diving on its pristine reefs, and also a huge variety of entertainment during the day. The majority of tourists arrive on Cozumel Island by cruise ship, but also through day trips from the mainland; the most welcome are those staying overnight at the 45 hotels, who spend an average of 538 USD over 3 days (SEDETUR, 2012).

Once the population target could be randomly reached in the field, the measurement tool was developed to study behaviours regarding plastic and food discards in the divers' household. The survey covers the variables presented in the model illustrated in Chapter 1 (see section 1.2), and responds with questions used in previous research by citing several scientists studying environmental issues and behaviours (Kaiser et al., 2003; Bortoleto et al., 2012; Rodríguez-Barreiro et al., 2012; Miao & Wei, 2013). Variables used in the study cover "***Household Attitude Toward the Behaviour***" where divers can register their responses on a Likert-type scale, "***Perceived Behaviour Control***" to verify if

divers have the ability to perform a given behaviour and are in control. ”**Socio-*Demographic***” variables were used to gain a better understanding of the person to be evaluated and provide a more accurate profile, “***Diving***” experience and level of certification was also used, and the last variable was “***Environmental Awareness***”.

The research assesses if U.S. scuba divers respect the environment by adopting attitudes that contribute positively to reducing their ecological footprint. Among divers there are certified ones and beginners, who perhaps already have beliefs about good practices for waste management, and in some cases being a scuba diver did not change their beliefs and behaviours regarding plastic and food waste. The presented model is quite ambitious as it aims to be more effective with newly certified divers. That is to say, this group in the study has never been exposed to scuba diving before, or only briefly, and the model aims to teach it responsible behaviour. Scuba diving skills are learned in order to observe marine life in a safe way and follow good diving practices. The educational program provided by Cozumel Reef National Park is very thorough, employing professional trainers to educate visitors about local environmental topics and how to reduce marine debris by respecting the marine environment. The water environment is the field for experiential learning, where divers experience a new sensation and becoming curious about this alien environment – water. The sensorial side is then activated and at this stage the study analyses whether or not the link has worked during the diver’s underwater experience. Therefore, the third key point focuses on the need to understand possible long-term impacts and whether changes can be made to environmental practices in the diver’s household, and what attitudes they might have in future to reducing plastic and food waste.

The fourth key point addresses the need to reinforce the importance of considering scuba diving activity as a tool for sustainable tourism development, as it moves many people, and thus currency, around the world bringing development to coastal areas and generating employment. There is the potential to use the activity for educating tourists about local practices and respecting the environment. Not only are tourists responsible for marine debris, also locals can educate and be educated themselves to carry responsibility for minimizing their ecological footprint,

Chapter 3

Making use of the model proposed in Chapter 1 and by proving the stated hypothesis, the study searches for answers to the specific questions about environmental practices and eventual behavioural change:

i. Does scuba diving activity have an influence on visitors' environmental behaviour in regards to plastic use and food waste in their household?

ii. Do participants change their behaviour after having been educated in scuba diving, or do they demonstrate a strong environmental conscience but continue the same practices at home?

In collaboration with the UQRoo, the PNAC office extended an invitation for participation in the training course for "Environmental education for tourism providers and volunteers in Marine Protected". During the training new information was collected and participants (professionals) were observed in regard to their opinions about the National Park practices and possible issues that could arise. Such participation was crucial in order to understand the real value of having diving professionals and boat staff educated beyond the dive training agency program; they are on top of actual environmental practices and issues across the whole area (see appendix L).

The course has been taught since 1987 (Garcia & Dominguez, 1999), but a need was detected to develop a refresher course, and informal interviews were conducted immediately at the PNAC office in order to gain a better understanding of the contribution of the course review and the variables created for analysis of the previous5 years of the training course. As a result of such cooperation, a scientific article was written reporting the case of Cozumel Reef National Park. The article acted as a registry update of the course database up to the last course taught in 2012, and included a list of suggestions for improving the efficiency of the course; verifying issues of data quality; providing evidence of participation in the course by tourism providers and volunteers; and of what practices are best for the ecosystem.

The methodology for researching environmental behaviours in the household regarding plastic and food discards has been generally delineated. The following sections will provide more detailed information about how the

measuring instrument was developed, and what statistical analysis is required to display results from the study using the instrument. Also, at the end of fieldwork a semi-structured interview was conducted, which was very important for collecting opinions about current practices on the reef, and what customers are interested in talking about. This second instrument was designed to interview a group of reliable professionals operating on Cozumel Island, who also provided valid information about marine debris on the island that was linked to environmental awareness and current practices on the island.

3.2. Designing the measurement tool

For studying divers' behaviour regarding environmental practices for plastic and food discards, a specific tool was developed for measuring divers' behaviour in the household. Attitude is commonly accepted as a variable to explain or influence behaviour; however, as mentioned before, Fishbein and Ajzen (1975) explained the reasons why it cannot be measured directly. The process requires observed behaviour, which also needs to be consistent overtime. People behave in a certain way because they have their own beliefs about a certain object and are constantly stimulated to perform a required behaviour. However, the more time that passes from the moment information was first received the more likely it is that inconsistencies will start appearing and the individual will most probably then change their behaviour. People must be motivated to perform certain behaviour, and so the measurement tools presented in this research aim to produce behavioural change by raising awareness among divers.

Gathering knowledge about actual behaviour is not an easy task to perform; theoretical models associated with statistical calculation need to be implemented and adapted to the objects in the study. The previous chapter recalled the whole process for defining behaviour and the conditions necessary for performing behaviour. The information collected was organized into clusters, providing guidance for formulating the sample size equation, and stipulating the minimum number of cases necessary for running statistical analysis. Bias was another concern taken into account when designing the measurement tool.

Afterwards, divers participating in the study can already have a strong inclination towards good environmental practices, which then biases the results (see section 3.2.2). Being a member of an environmental organization might add bias to the results, although it could be very interesting to compare results and verify if such membership actually carries responsibility with it and shows a difference in behaviour.

The model presented is more suitable for measuring student divers who have not been exposed to scuba diving before, but it can also measure certified divers with particular attention to those taking a course of further education on diving. With student divers, there is the chance they will exhibit similar attributes to certified divers, but will always lack the diving experience and water as stimulus for behavioural change. In this manner, the water environment plays an important role for research, as it is essential for the experiential learning process and marine debris observation.

Among tourists visiting Cozumel Island, many divers will sign up for day excursions to the local reefs. These divers will have diving certifications and experience in the open water, ranging from the recently certified to the very experienced. Experience in scuba diving cannot be measured equally for every diver; likewise holding many diving certifications does not necessarily confer as much experience as the word might suggest. Comfort levels must be achieved, and diving must be performed in a repetitive way, using common sense and safety. For example, divers of experienced certification levels, but who have not been active for a long period of time and divers with many hours logged submerged in lakes or quarries who then go diving in open-water conditions lack experience and they should undergo a refresher course to regain confidence in their diving skills. Experience can be gained by diving regularly in different environments such as in currents, at night or with reduced visibility, or boat or shore diving, etc. Also time, comfort, light and geographical location can affect experience. Temperature alone is an aspect of experience as it changes personal levels of comfort, and thus counts as experience. According to the various diving standards (e.g. PADI, NAUI, SSI, SDI) certified divers are responsible divers, who should scuba dive in locations representative of their training conditions. For further experience it is highly recommended to seek additional training or be monitored by a diving professional. At every level of certification, a different diving theory is delivered to students and the existence of

such levels is not only for commercial purposes, but also for instructing divers regarding diving skills, practices, safety and ethics. Once they have built up experience, divers should be regularly active and experience different diving conditions if they are to be considered experienced divers. Thus the developed tool is designed for reaching distinct groups of divers:

a) certified divers looking for a diving holiday;
b) divers with previous certification, but engaging in further diving education;
c) participants taking a scuba diving course;
d) non-certified divers participating in a “one-day experience” with a diving instructor, which could be a try dive, discover scuba dive or resort dive.

A very important control question in the tool pertaining to certified divers aims at understanding if scuba diving had, or still has, any influence on behaviour towards the environment. This is because it is important to know if behavioural changes in the divers’ household were produced from experiencing scuba diving.

In the previous chapter, variables for modelling were outlined and used to build the proposed model for verifying the hypothesis. For every variable mentioned, there was an adequate literature review supporting the questions listed in the tools. Studies on marine debris led to a search for municipal solid waste indicators, giving a target population to study, and what type of waste should be more significant for this research. The required questions for providing input for each variable in the study were taken from several scientific documents (see: Kaiser et al., 2003, pp.15,16; Bortoleto et al., 2012, pp.2198,2199; Rodríguez-Barreiro et al., 2012, p.8; Gunders, 2012; Miao & Wei, 2013, p.106), which reported studies on ecological behaviours, waste prevention, environmental impacts and pro-environmental behaviour.

For food-discard-related questions, Gunders’s (2012) report proved to be a great reference for searching relevant items, and was used previously by scientists. Food losses along the supply chain are well illustrated with several charts, with abundant information for addressing the issue.

Kaiser et al. (2003) referred to the vital need for studying pollution levels, and the need to save energy and resources, despite the fact that environmental psychologists had conducted little research on it. Personal impacts on the environment and natural resource consumption are also important to measure; therefore, his research paper aimed to "ecologically validate 52 behaviours of a well-established self-report measure of ecological conduct" (Kaiser et al, 2003, p.11). This paper contributed with four important questions to add to our measurement tool, describing household attitude toward behaviour (2 questions) and environmental awareness (2 questions).

Bortoleto et al. (2012) developed a model for household waste prevention, which is suitable for use as a tool for governance and assists in understanding how to reduce waste and prevent behaviour. Bortoleto et al. merged the Schwartz's altruistic behaviour model and Fishbein and Ajzen's (1975, 1991) theory of planned behaviour for waste prevention, indicating that "personal norms and perceived behaviour control are the main predictors and that, unlike the case of recycling, subjective norms have a weak influence on waste prevention behaviour.… Waste prevention behaviour is likely to be influenced by concern for the environment and the community, as well by perception of moral obligation and inconvenience." (Bortoleto et al., 2012, p.2195). The results from Bortoleto's research demonstrated the effectiveness and good reliability of the theory of planned behaviour for modelling participation in waste prevention. Five questions were included in our model from Bortoleto's model, which describe attitude towards behaviour, and one for perceived behaviour control.

One question for describing attitude towards behaviour was used from Rodríguez-Barreiro et al.'s (2012) research, in which sixty graduates from the University of Zaragoza were measured in five different categories (formation, outreach activities, conservation, intention to act, and environmental behaviours), using a validated Likert scale. The study examined the relationship between environmental attitudes and pro-environmental behaviour in participants belonging to departments offering environment-related courses. The model revealed that conservation and intention to act was being strongly related to pro-environmental behaviour.

Mia and Wei (2013) studied the pro-environmental behaviour of 1,185 people, using 21 items from previous scientific works, and showed that they had

a higher level of pro-environmental behaviour in the household than when staying in a hotel, which was evidence of behavioural inconsistency. From this study four statements were used to complete the array of questions for studying the household attitude toward behaviour.

The use of socio-demographic variables offers a chance for understanding where divers come and to compare levels of achieved behaviour, for example, between those living on coastal areas or more inland, or if the size of their living area also affects behaviour. Geo-location (DEMA, 2006) can provide important data for referencing and comparing with previous studies. Also from our sample, divers' profile was compared to previous studies (Ditton & Baker, 1999; Mundet & Ribera, 2001; WTO, 2001; Musa, 2003; Grőssling et al., 2004; Todd, 2004; Tourism of Queensland, 2006; Belknap, 2008; Ong & Musa, 2011) and contributes to updating the world reference for studies about scuba diving activity.

As already mentioned, the study aims to assess certified and non-certified divers, who are already participating in a diving experience, be it a training course or a day experience. The tool is composed of three phases:

I. Every diver, both certified and uncertified, was given the first document, as described above, on which all questions had been validated by previous studies.

II. Only student divers participated in the second phase, which aimed to assess the activation of the sensorial side, with questions dealing with levels of consumption of plastic-related products while on the island or undergoing a diving experience. It also noted divers' suggestions for behavioural change in their household to reduce marine debris.

III. Only divers who volunteered participated in the last phase. Both certified and student divers were sent a personal invitation to fill out the web survey. Some questions were adapted and some were newly added to verifying whether divers had changed their behaviour, or if they were happy just at being more aware of the issue, but without taking any action.

The references used for designing the second stage of the measurement tool were found on the PADI AWARE Coral Reef Conservation Specialty Diving Course and the Project AWARE website. This second document illustrates the "Dive Against Debris – Self-Study Guide" and can be downloaded free from the Project AWARE website(s), and is available in nine languages. This guide provides important information about marine debris regularly found at diving grounds or coastal areas. The whole document is a must read for those looking for information on beach or reef cleaning. The public can become informed about what marine debris is and especially what impacts it can create for marine life. Dive Against Debris offers some organizational recommendations for safety, objective reef cleaning, and gear to use, etc. It also recommends using the Dive Against Debris card, which can be downloaded and printed out to give better guidance and acknowledgment. Diving procedures are very important and the document defines clear strategies for retrieving debris without endangering divers in the water, and about what debris to target if it is encountered at different sizes, etc. Once everybody is out of the water, procedures for sorting, recording, and disposing of the debris are suggested based on experience and, of course, taking into account the need to adapt to every situation/location. Finally divers can report their data online on the Project AWARE website.

The measurement tool is a document built to register specific observations during the peak period for scuba diving on Cozumel Island. Every survey was assigned a serial number, which assisted in the process of tracking and setting up the database. In adherence to the Federal Law for Personal Data Protection in Mexico (LFPDPPP, in Spanish) from 5th July of 2010, and the Federal Privacy Act in the United States of America from 1974 (PA, 1974), participants were informed about the confidential use of the data for academic purposes. The edition of any scientific work related to this study, will be published without revealing participants' name, address or email. Also to avoid any legal issues or misunderstanding about the online survey, only people aged 18 years and over could participate in the study (see appendix A).

The first two phases of the measurement tool provide quantitative data for research, and the minimum number required for cluster analysis was achieved during fieldwork. Data handling will be described in the next sections, providing information about the database set for use on SPSS 20, likewise the coding required for handling the data. Nevertheless, it is necessary to follow

theoretical fundaments for statistical analysis, which are suitable for running the proposed model and will increase the reliability of the instrument.

3.2.1. Cluster analysis for Cozumel diving visitors

Cluster analysis can be used for exploratory analysis and for solving problems classifying “members of a population” in the study. The methodology organizes objects (people, houses, plants, animals, flowers, etc.) into groups, called conglomerates or clusters, which have similar properties or are in some way directly connected and are dissimilar to object members from different clusters. Such aggregation gives power to the cluster which is much stronger between members belonging to the same cluster than to different groups. The analysis finds “shorter” connections in latent data which can become relevant once they are displayed (Villardón, n.d.).

A typical description for cluster analysis is the hierarchic method with an increasing number of connected classes, forming subsequent conglomerates and divisions of clusters. In non-hierarchic methods, classes are not connected on hierarchy, but can be shifted among clusters during the formation process.

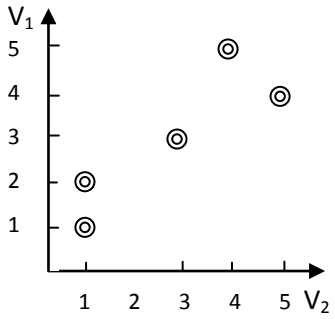
The hierarchic conglomerate requires a decision to be made for which data will form each cluster, usually using the same type of variables for running the analytical model (continuum, categorical, etc.). For deciding on the initial class of cluster, distances must be selected between the objects to classify (centroid, nearest neighbour, within-groups linkage, Ward’s, etc.), and only then the algorithm starts looking for similarity among clusters, using one of the indicated measures such Euclidean distance, Chebycheb, etc. Similar clusters are taken into a new cluster with at least two objects, in such a way that the total number of clusters decreases by one unit, and then the distance is calculated between the new cluster and the rest. The whole process is repeated with similar clusters until all objects are in only one cluster.

Cluster analysis aggregates similar objects in one cluster, which contains objects quite dissimilar from other clusters. In the case of U.S. scuba divers, the study aims to obtain segments for better description of responsible behaviour in the household, regarding good practices for waste management, in particular for

plastic and food discards. Using for example the 5-point Likert-type scale in Table 3.1, the study of divers' attitude (V_1) regarding the use of plastic bags (V_2), assigns the highest value to the higher degree for attitude toward the behaviour by using plastic bags.

Table 3.1: Likert-type scale used for registering divers' attitude toward behaviour, and respective orthogonal representation

Object	V_1	V_2
1	1	1
2	2	1
3	4	5
4	3	3
5	5	4



Source: Mota, 2013.

The cluster analysis links variables with similar scales and form clusters, identifying groups of similar objects. For measuring similarity, for example, hierarchical methods can be used for specifying similarities and identify different clusters. A common practice in the majority of software programs is to estimate the distance between a pair of objects; for shorter distance between them, the greater the similarity they have. Important decisions must be made for choosing how many clusters we want to obtain, and as a rule fewer clusters always provide easiness for understanding and explain similarities.

Figure 3.1 illustrates the different methods for clustering objects and the important steps to follow. Hierarchic methods require a decision to be made for the initial class to form the cluster and objects cannot be moved between clusters, whereas portioning methods and two-step clusters create a big cluster and shift objects between clusters. For analysing the sample obtained during fieldwork on Cozumel Island, the two-step cluster method was used, which is a combination of a hierarchical and non-hierarchical method (K-means).

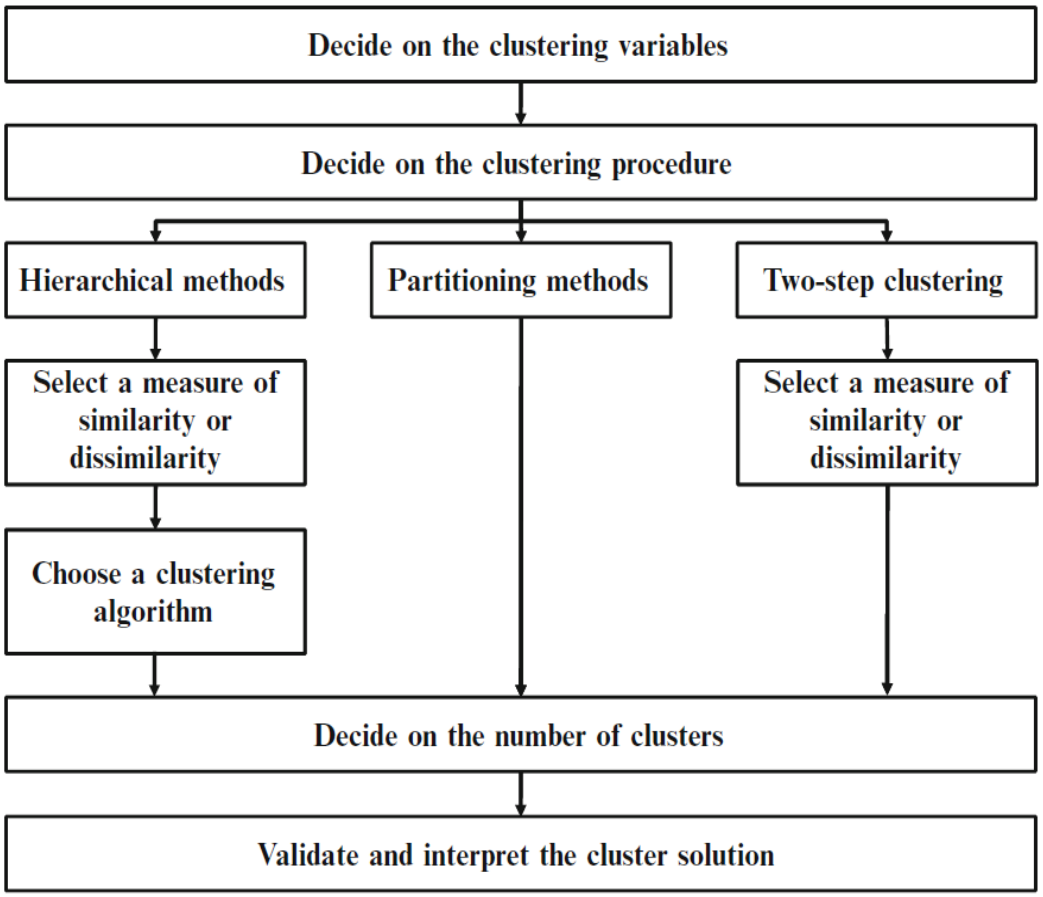


Figure 3.1: Steps in a cluster analysis. Source: (Mooi & Sarstedt, 2011, p.240).

The interpretation of the cluster provides the relationship between variables, measures the variables' mean values or gives a profile with explanatory variables. The solution requires stability and validity.

Choosing appropriate variables for clustering is very important as the variables need to make sense for analysis and be compatible for the description of the cluster. A variable tree was developed for powering the outcome of the model (see Appendix G); variables were represented in each response level, giving strength to the outcome of the survey and offering a better interpretation when crossing information.

Variables can be classified as general variables, which are independent of any product, services offered or any circumstances that make them real; specific variables, which relate divers to the issue under analysis, in this case divers' attitude toward the behaviour for reducing marine debris; also variables

can be directly observable if divers are measured directly for their behaviour, and unobservable (inferred) if not (see Table 3.2).

Table 3.2: Typical variables for measurement.

Variable	General	Specific
Observable (directly measurable)	Geographic, demographic and diving.	Certification level, number of dives, overnights, education level, age, observed debris, etc.
Unobservable (inferred)	Psychographics, values, personality, lifestyle, awareness.	Benefits, perceptions, attitudes, intentions, preferences, behaviour, etc.

Source: Adapted from Wedel and Kamakura (as cited in Mooi & Sarstedt, 2011, p.241).

The type of variables seleted for cluster analysis has a direct influence on the segmenttarget when identified by means, andspecific inferred variables tend to form a more homogeneous cluster (Wedel & Kamakura, 2000), although variables that are easy to measure need to be assisted with segments to make divers' behaviour easy to measure. Having a certain socio-demographic profile does not necessarily match with divers behaving more, or less, in favor ofreducing debris. Combining different variables (demographic with attitude toward the behaviour; diver certification with attitude toward the behaviour; or number of dives with divers' household attitude toward the behaviour) gives strength to the cluster.

Whatever variables are selected, it isimportant to provide a clear differentiation for the behaviour to measure, also clustering too many variables produces low levels of differences and not longer dissimilarity. Also by using high-correlated variables for clustering, the segment can become overrepresented in the solution; Mooi and Sarstedt (2011) recommended using correlations below 0.90. For example, if a new variable called "plastic container" is introduced in the model, it might cover the previous "using plastic bags", thus

the concept to be analysed can be overrepresented due to high colenearity as the algorithm assumes the same concept for both variables.

The cluster is formed independently of sample size; Formann (1984) recommended the measure of 2^m for a minimun sample size, with “m” representing the number of cluster variables. Section 3.2.2 provides more details in the sample size elected for fieldwork, and describes the sampling framework. From the measurement tool, variables need to be selected for clustering by contrast through disimilarity, avoiding high similarity among the cluster if all will be introduced, variables need to have a contex influence.

Clustering procedure

Hierarchical clusters are characterized by the representation of a tree-like structure, starting with anindividual cluster formed by all objects. The method merges similar objects describing consecutive steps, forming the two most simillar clusters, followed by another pair of clusters formed on the descendent hierarchy (see Figure 3.2).

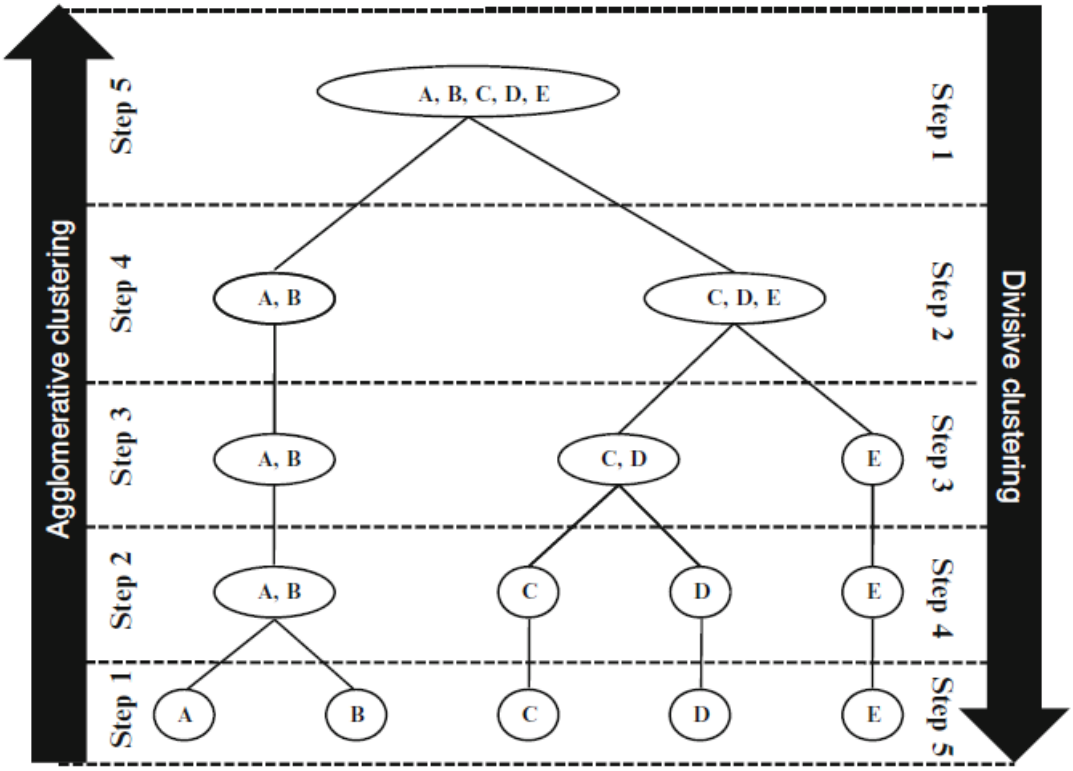


Figure 3.2: Agglomerative and divisive clustering (Mooi & Sarstedt, 2011, p.244).

Selecting a measure

In hierarchic clusters, objects are assigned to clusters based on similarities belonging to that same cluster, and cannot be assigned to another neighbouring cluster. The hierarchy always contains lower levers formed from the previous cluster.

For example, interpreting Table 3.1 with the orthogonal scattered points, represented by v_1 and v_2, we can easily see the shorter distance between the object 1 and 2. This same distance defines the Euclidean distance (or a simple straight-line distance), and is one of the most common methods in use for analysis of ratio or interval-scaled data (Mooi & Sarstedt, 2011). The distance between two points can be given by the square root of the sum of the difference in the variables.

$$D_{Euclidean}(1,2) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \quad (3.1)$$

$$D_{Euclidean}(1,2) = \sqrt{(1-2)^2 + (1-1)^2} = 1.0$$

For each additional object, one additional dimension must be added (four objects require four dimensions), and all expressed by means of a distance matrix (see Table 3.3). The values represent each mean distance between two points, with the diagonal by zeros (the distance from each point to itself) and the non-diagonal expressing the Euclidean distance between pairs of points.

Table 3.3: Euclidean distance matrix for the points represented on Table 3.1.

$D_{Euclidean}$	1	2	3	4	5
1	0.0				
2	1.0	0.0			
3	5.0	4.5	0.0		
4	2.8	2.2	2.2	0.0	
5	5.0	4.2	1.4	2.2	0.0

Another method for measuring distances between points is called the “city-block distance”, often called the Manhattan metric for its walking distance between two city blocks. In any cardinal direction (e.g., north-south or east-west) the distance equals the number of blocks walked through. The distance matrix can be represented with distances between points.

$$D_{city\text{-}block}(1,2) = |x_1 - x_2| + |y_1 - y_2| \quad (3.2)$$

$$D_{city\text{-}block}(1,2) = |1 - 2| + |1 - 1| = 1.0$$

Also it is common to use the Chebychev distance when handling metric or ordinal data, which gives the maximum of the absolute difference.

$$D_{Chebychev}(1,2) = \max(|x_1 - x_2|, |y_1 - y_2|) \quad (3.3)$$

$$D_{Chebychev}(1,2) = \max(|1 - 2|, |1 - 1|) = 1.0$$

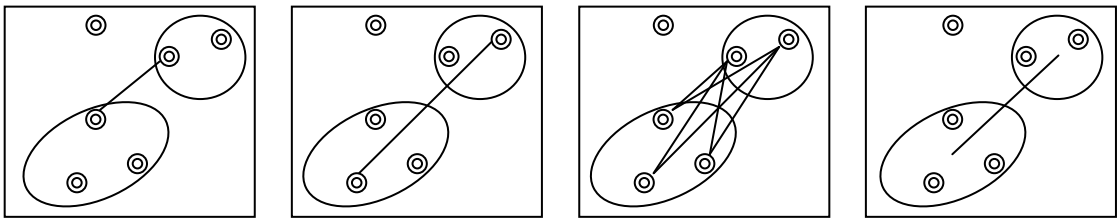
In cluster analysis there are other methods for measuring the distance, such as Angular, Camberra or Mahalanobis distance, but they are not listed in the SPSS IBM software package used for analysis of the population in the study.

Cluster algorithm

After choosing how to measure similarity of variables, there is the need to decide on a clustering algorithm; from at least four different algorithms (e.g., single linkage, complete linkage, average linkage, and centroid) one procedure must be used to define the distance from new clusters to a certain object:

(1) The single linkage bounds with two members of different clusters by choosing the shortest distance or nearest neighbour for the complete linkage.

(2) The complete linkage aims for the longest distance between any two members from two clusters.
(3) The average linkage measures the average distance between all parts between the two clusters.
(4) The centroid links the geometric centre of two clusters.



(1) (2) (3) (4)

Figure 3.3: The four linkage procedures for two random clusters (Mota, 2013).

For each clustering algorithm, different results will arise when computing the data. According to Mooi and Sarstedt (2011) the single linkage produces one initial large cluster containing other clusters with one or several objects inside. Through this process, outliners can be detected then the eventual suspicious correlations merged with the remaining objects; this is the most versatile algorithm.

Outliners strongly affect the complete linkage due to the long distances to measure; clusters tend to be quite small or compact. The other remaining algorithm (the average linkage and the centroid) usually produces clusters of similar size and low variance among the cluster members, and it is also affected by outliners.

An example of a visual interpretation of how clusters are distributed, is the distance at which level objects were combined; similar objects are connected and represented in the dendrogram.

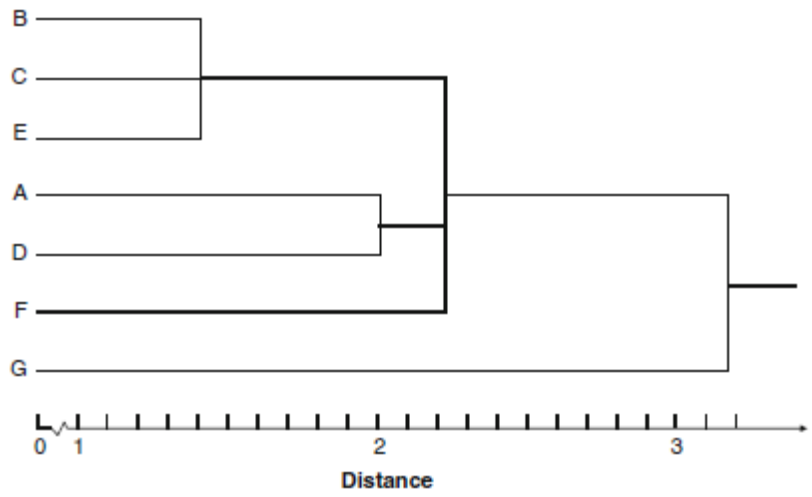


Figure 3.4: Example of a dendrogram, representing hierarchic clusters (Mooi & Sarstedt, 2011).

Partitioning methods: K-means

The K-means differs from the hierarchical method by not using Euclidean or city-block distance in the algorithm; it rather uses the within-cluster variation for measuring objects and forming homogeneous clusters. The process starts assigning objects to the cluster; the random process is then repeated by moving objects between clusters in a way that within-cluster variation again becomes minimal.

In the K-means process, there is no need to decide for the first partition as objects can shift from one cluster to another, and also prior to analysis the K-means asks for the number of clusters to form (see Figure 3.5, K-means step 1). The Euclidean distance computes only the distance from each object to the cluster centre (K-means step 2), where each object is measured for assignment to the cluster nearest to it. Having the initial partition as a reference for each variable, the mean of the values in the cluster computes a new geometric centre computer, (K-means step 3). The new cluster centre is calculated for minimal within-cluster variation, also can include outliers and different solutions can also arise (K-means step 4). K-means is used for handling large data sets, as it is not required to define any hierarchy, being less computational. Also it is less sensitive to outliers and irrelevant correlations. Mooi and Sarstedt (2011)

recommended K-means for data sets with a minimum of 500 cases, particularly if many cluster variables are used.

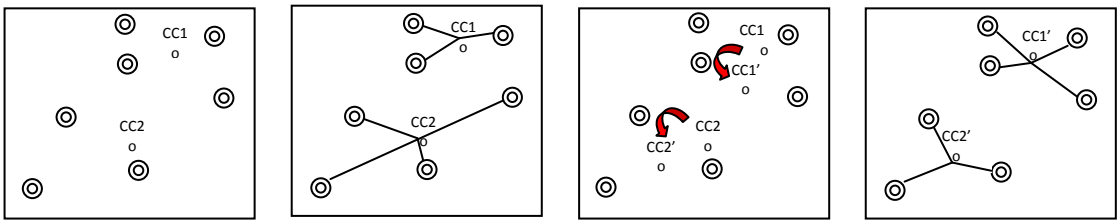


Figure 3.5: The four linkage steps for two K-means random clusters (Mota, 2013).

Two-Step clustering

Cluster techniques distribute objects along a hierarchy from top to bottom, or assign objects to different clusters formed, shifting them until the required number of clusters is found. In hierarchical methods, clusters can be either agglomerative or divisive depending on the start point. When clusters are formed with a single object, agglomerates can be produced by ascending up the hierarchy and merging the two "closest" clusters (see Figure 3.2). The opposite flow happens by dividing the initial cluster containing all relevant objects so that it is sub-clustered into smaller ones and the initial value for the hierarchy does not need to be set.

The Two-Step cluster method developed by Chiu, Fang, and Chen (2001) is a combination of hierarchical and non-hierarchical methods, and allows the use of different types of variables. Based on a two-stage approach, the procedure results in a random process, rearranging objects on consecutive iterations. From this operation, the two-step procedure modifies the hierarchy of the clusters, combining them to form homogenous clusters.

Different types of variables can be introduced for clustering, as continuous and discrete variables do not require to be represented on a specific type of scale. Scales can be analysed with their original value without conversion for fitting in the model. The cluster number can be selected by the user, or the model will automatically find the optimal number of clusters. In Two-Step

clustering, the procedure indicates the importance of each variable for forming the cluster.

The basic concept of the Two-Step cluster is handling large data sets, combining procedures for more effective data handling of smaller sample sizes, and playing different types of variables (Zhang Ramakrishnon & Livny, 1996).

In our sample, the number of cases and variables are scanned for merging with the next cluster; the assignment is based on the distance criterion. Each entry is characterized by the number of cases, the mean and variance from the introduced continuous variables, and also all categories formed by categorical variables. Such entries build up the cluster feature (CF) tree, which consists of different levels of nodes containing each entry. The SPSS allows three levels of nodes, containing each a maximum of eight entries, supporting the total of 512 sub-clusters (8^3). Starting from the root node, values are guided by the closest entry in the node, descending along the CF-tree, when reaching the leaf node, the value also seeks the nearest leaf entry and is absorbed if the minimal distance requirements are met. In case the leaf entry is full, the leaf node is then split in two and all entries from the node are adjusted using the furthest pair as seed; then the entries are rearranged again based on the closest criteria.

This clustering method can solve problems with outliers caused by noise, or correlations that are difficult to fit into a cluster. In a simple way, the algorithm rebuilds the CF-tree and searches for atypical values; at the end of the process the algorithm again tries to assign such values, and label them as outliners if they still cannot fit into a cluster.

In Two-Step cluster analysis, both Euclidean and log-likelihood distance can be used for calculating the distance between clusters; the former is used for all continuous variables, and the latter assumes normal and multinomial distributions for continuous and categorical variables, respectively (Schiopu, 2010). The log-likelihood “quantifies the standardized distance between a participant’s data points and the parameter of interest (e.g., mean, etc.), and the goal is to identify parameter estimates that minimize these distances” (Baraldi & Enders, 2010, p.19).

From the sub-clusters formed, traditional methods (hierarchic or partitions) can be more effective for analysis. Two-Step cluster uses two stages for automatic determination of the number of clusters. For a specific range, the

Bayesian Information Criterion (BIC) proposed by Fraley and Raflery (1998), or the Akaike's Information Criterion (AIC) is calculated for each number of clusters; the indicator is then used to estimate the optimal number of clusters (Schiopu, 2010; Mooi & Sarstedt, 2011).

For validation of the clusters formed in the previous steps, it is recommended to use different clustering procedures, for instance BIC or AIC for calculating each number of clusters. Another technique is to split the sample into two halves and analyse it again using the same method and preferences. When comparing both two solutions separately, they should not differ significantly, and therefore the overall solution should have much more validity and a higher degree of stability. Also for testing, the sample should be organized in a different order so as to give a reliable solution; otherwise outliners will influence the results.

To assess the criterion's validity, a variable is not used to form the cluster, rather a theoretical relationship must be used for detecting distinct groups with the selected criterion. The use of such a criterion must show a significant difference. For example, when clustering household attitude toward the behaviour, the cluster can be validated using perceived control behaviour (looking for recyclable products has become part of my routine). When using the criterion, the prediction value must be significant.

Finally, the interpretation of the cluster solution needs to be referred to the cluster centroid, which is the average variable value. According to the SPSS 20 user manual, clusters must present different means to be distinguished, using analysis ANOVA, t-test samples, or the Chi-square test, which is a goodness-of-fit test, to compare "observed and expected frequencies in each category to test that all categories contain the same proportion of values, or test that each category contains a user-specified proportion of values" (IBM SPSS, 2011, p. 233).

3.2.2. Sampling for research

Studying environmental behaviour with the aim of reducing marine debris, reveals an international problem related to municipal solid waste and

personal engagement. Governments are struggling to deal with such waste generation rates, and finding solutions to reduce, reuse, recycle or dispose of garbage must meet sustainability requirements.

From the many different types of tourists visiting Cozumel Island, scuba divers were chosen as the population to be studied. The aim was to gain an understanding of their relationship with the environment, where responsibility would be measured in regard to their active pro-environmental behaviour. Divers can increase their environmental awareness through their regular exposure to the water environment, enabling them to notice and report impacts from pollution (PADI, 2005). Furthermore, the study examined divers' behaviour for reducing their ecological footprint, through measuring their attitudes in the household regarding the purchase of essential goods related to plastic and food waste.

Modelling the problem approach has driven to the observation of marine debris, and registering how it appears in the water, what form it has, and how much impact it can have on marine environments. Plastic is the major component of marine debris and today it is a common part of human life (WSPA, 2013). The model assesses whether participants changed their behaviour after being educated in scuba diving, or if they demonstrated a strong environmental conscience but continued with the same practices at home.

Cozumel Island is visited by an enormous number of divers of different nationalities with the majority arriving from the U.S., which defines the sampling frame for the population to be studied (Cozumel divers). Certified divers living in the U.S. and tourists motivated to go scuba diving who were on a visit to Cozumel Island, were assessed in PADI diving schools on the island. As a resume, Table 3.4 provides the sample description with the sampling framework, which was used as a guide for developing the measurement tool, and was crucial for sample sizing.

Finding the minimum sample included a few techniques used for avoiding bias; for example, participants were screened for membership of environmental organizations as they can have different motivations for having active pro-environmental behaviour. Although for comparison with the rest of the population in the study, divers' memberships of such organizations were kept on record. Nevertheless, bias can be produced by having selected the minimal age for participating in the survey, which was stipulated as 18 years. According to dive training standards, participants must be at least 10 years old to receive a diving

certification for open-water diving, but until the age of 18 years it is normal for most people to live with parents or guardians, and be subject to their house rules for waste management and disposal.

Table 3.4: Description of the sampling framework.

Sample description	
Universe:	All tourists visiting Cozumel Island.
Population:	Tourists who are on Cozumel Island for scuba diving.
Unit for analysis:	Waste management practices for plastic and food discards in the divers' household.
Sampling framework:	- U.S. tourists or tourists with official residence in the U.S, - Diving schools registered on Cozumel Island. - Certified divers, - Diving students, - Participants not holding membership of environmental organizations, - Participants with a minimum age of 18 years.
Sampling units:	Diving tourist's environmental behavior in the household regarding plastic and food waste management.
Sample:	Tourists from the U.S. participating in scuba diving activities on Cozumel Island.

Source: Mota, 2013.

Collecting reduced unbiased samples was done using a random sampling technique, whereby U.S. scuba divers were selected for studying divers' waste management behaviour. They were chosen by chance from all divers signing up for day excursions during a period of sixty six days, and had a possible and non-equal chance of becoming part of the sample. Only chance determined which members of the population would be included in the sample, as all members of the population in the study had the same chance of being

invited for selection (Bhattacherjee, 2012) on random days, both for certified divers and divers seeking diving training experiences.

For instance from the twenty seven PADI dive centres registered on Cozumel Island, only eleven demonstrated an interest in participating in the fieldwork study, which reduced the number of schools represented in the sample. Thus, daily customers were randomly assessed for the study. The PNAC (2013) reported that 1,500 people enter the marine protected area each day; these numbers include both scuba divers and snorkelers, and also scuba diving takes place on reefs located outside the protected area. Therefore, the actual number of scuba divers visiting the reefs of Cozumel Island is unknown.

When participants from the fieldwork survey responded to certain variables, listed in the measurement tool, that response was the observation registered using, for example, a Likert-type scale. Every participant registered different responses, which can be displayed on a graph of frequency distribution. Large numbers of responses can produce a bell-shaped curve, which is the normal distribution used for estimating the overall tendency of an entire sample using the average record of all observations, or standard deviation by picturing the spatial spread of the observations (Bhattacherjee, 2012).

Due to it being impossible to include the whole population, sample statistics can carry errors, represented by the difference between the real population parameter and the sample representative of the same population. In our sample, for instance, three different random sample values could be taken, and their respective mean and standard deviation calculated. If the sample really represents the population in the study, then their mean must be similar to the population's mean, and therefore the variability of the sample equals zero.

The probability of this event is very low due to the three sample values representing a subset of the population showing a slight difference in their means. However, it is possible to represent the sample means values on a histogram. If the number of samples increases from three to ten to one hundred, then the frequency histogram can be converted to a sampling distribution, which is the distribution of a sample statistic derived from a set of samples. The spread of the sample statistic in a sampling distribution is called the standard error. The mean value of the obtained sample statistic is therefore an estimate of the unknown population parameter.

The probability of finding the real value of the population carries a confidence interval of, for example, 95%, which is the same as saying that 95% of cases in the analysed distribution can be found within two standard deviations of the mean (see Figure 3.6). Therefore, the estimated value for our sample statistic ± two standard errors, represents a 95% confidence interval for the real population parameter (Bhattacherjee, 2012).

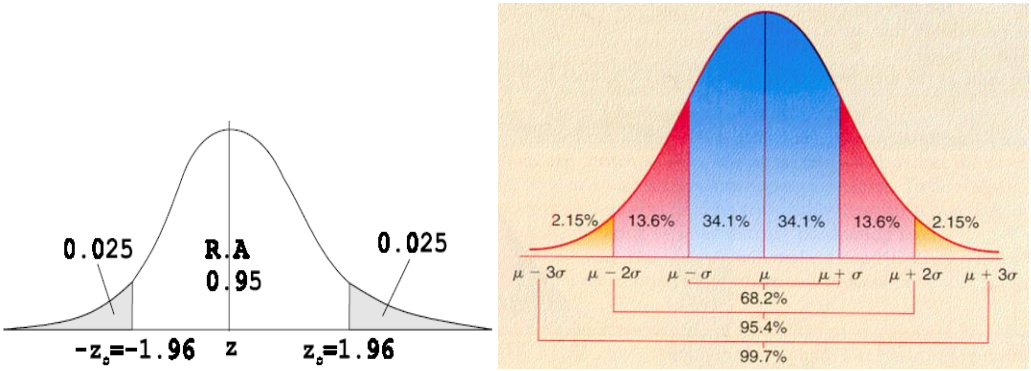


Figure 3.6: Normal distribution with α = 0.05 (Díaz Busto, 1984), and representation for 68% (σ), 95% (2σ), and 99% (3σ), source:www2.mcdaniel.edu, 2013.

For estimating the minimum number of participants to sample from an unknown population, measurements were taken with a 95% confidence interval and the expectation of having a 10% sampling error (see formula 3.4).

$$n = Z^2 \, p.q/i^2 \qquad (3.4)$$

$$n = 1.96^2 \times 0.5 \times 0.5 / 0.1^2 = 96.04$$

where:

- n represents the number of participants to survey;
- Z is the value of a normal distribution, with α = 0.05 and z=1.96;
- p is the prediction of the value to estimate for the population proportion. In an unknown population, the most unfavourable option (p=0.5) provides a bigger sample size;
- q is 1- p;

i represents the prediction of the sampling error. For example, with10% error, if the estimated value is 85%, it is 95% (α = 0.05) certain that the real value is between 75% and 95% of the sample.

Despite Formann (1984) recommending the measure of 2^m for a minimum sample size, with “m” representing the number of cluster variables, and the cluster being formed independently of the sample size, for security 97 participants were selected as a minimum target to be achieved during fieldwork. Obtaining entries above the target grants the minimum requirement; in case some surveys needed to be rejected due to having too many missing values, illegible letters, water damage or being lost. Using a 5% error in the sampling process would be ideal, requiring a requiring a bigger size sample, but 10% is also accepted for sampling (Valledor, 2000) as it fits well with the distribution of the population sampled. On Cozumel the majority of students were participating in one-day try-diving experiences, which could therefore lead to under-representing the core courses, which take longer to complete.

3.2.3. The measuring tool

Giving the same importance as the literature review and the fundamental theory for supporting the proposed model, the measuring tool is the instrument developed for collecting inputs for analysing the hypothesis. In order to have a representative sample, the tool follows a very strict methodology for statistical analysis, whereby each construct is verified for strength, reliability and power as predictor for behaviour in the household.

The variables presented in the model respond to a series of observations collected directly from the participants during each of the survey phases. Previous studies on nature-based tourism (Orams, 1996; Musa et al., 2006; Belknap, 2008; Ballantyne, 2007, 2009, 2010) involved researchers collecting direct observations (Santander & Propin, 2009) or through organizing pre- and post-questionnaires (Grőssling et al., 2004; Moscardo & Saltzer, 2004; Belknap,

2008; Ong & Musa, 2011; Ballantyne et al., 2010; Minnaert, 2012) to register post-experience outcomes.

Ballantyne et al. (2010) tested short- and long-term impacts of wildlife tourism experiences in four Australian cities offering marine wildlife tourism experiences (an aquarium, a marine theme park, a turtle nesting and hatching experience, and a whale watching experience). Pre- and post-visit questionnaires were used, and four months after the tourism experience, participants were asked to complete a web survey in order to measure long-term impact. To measure longer-term impact, Falk (2007) assessed visitors seven to eleven months after a visit to eight tourism experience centres in the U.S. (one museum: Sonoran Desert Museum; three zoos: Brandywine Zoo, Bronx Zoo, Binder Park Zoo; and four aquariums: Florida Aquarium, North Carolina Aquarium-Roanoke Island, Monterey Bay Aquarium, Aquarium of the Pacific) using both telephone and e-mail interviews.

Likewise in this research, participants were approached, mostly, in registered diving schools were they were asked to fill out a 3-to-5-minute survey. The first was administered before or after the experience as it is designed for studying current behaviours in the divers' household regarding plastic and food discards (see appendix A). However, the second-phase survey was required to be filled out after completing two dives or the whole experience (see appendix B). This condition was set as a requirement to ensure participants had spent enough contact time in the water, so they could be more focused on observing marine debris. Based on experience, it is common to observe a lack of spatial awareness among beginner divers and that they do not pay attention to many details. There is always a lot of emotion when they report events that triggered their senses such as a feeling of peace while underwater, how referential points moved so fast due to their displacement in the current, the little buoyancy control they had, and the "most wanted to see" species they observed like sea turtles, etc. Having good body control can be achieved through relaxation, which is very important for feeling comfortable in the water and enhancing buoyancy control to be able to observe the multitude of details and attributes on the sea floor.

The measurement of long-term impact from scuba diving activity on potential behavioural change in the diver's household was recorded four to six months following the diving experience on Cozumel Island (see appendix C). By then, the data base had already been set up and contained observations from

the previous steps. Further analysis was conducted for a quantitative representation of the predictors for behaviour. As mentioned before, the tool is composed of three phases and administered through surveys, with the information gained from the first two used for quantitative data analysis. Previous observations were transferred to the third and final survey and the results underwent qualitative data analysis only. Controlling and crossing data from previous surveys provides the possibility to report qualitative observations for behavioural changes produced in the household for plastic and food discards.

3.2.3.1. Variables for modelling

Variables used for registering observations were developed to give sense to the measurement tool. Crowding the variable tree document (see Appendix G) provided a better understanding of the different levels of information used for studying divers' behaviour in their household. Also projecting variables were developed based on the guidelines for collecting information, which gave strength to the research outputs. Through the variables listed in the surveys, certain characteristics of the population in the study could be registered such as demographic responses on a Likert-type scale, for example, or the number of dives could be counted. They are called variables because values change over time and differ between participants in regard to their characteristics, attributes and behaviour.

The measurement tool uses numeric variables for registering typical information from quantitative variables, which measure quantitative values. In addition, continuous variables can be differentiated, where observations can take any real number for expressing age or annual household income; or there can be discrete variables describing a set of natural numbers to describe, for example, the number of dives (see appendix F).

Also, there can be categorical variables describing certain characteristics like "What is your certification level?" or "In which part of the country do you live?" representing a non-numeric number, but a characteristic of a data unit. For further understanding of categorical variables, see Figure 3.7 in which variables are described as ordinal or nominal.

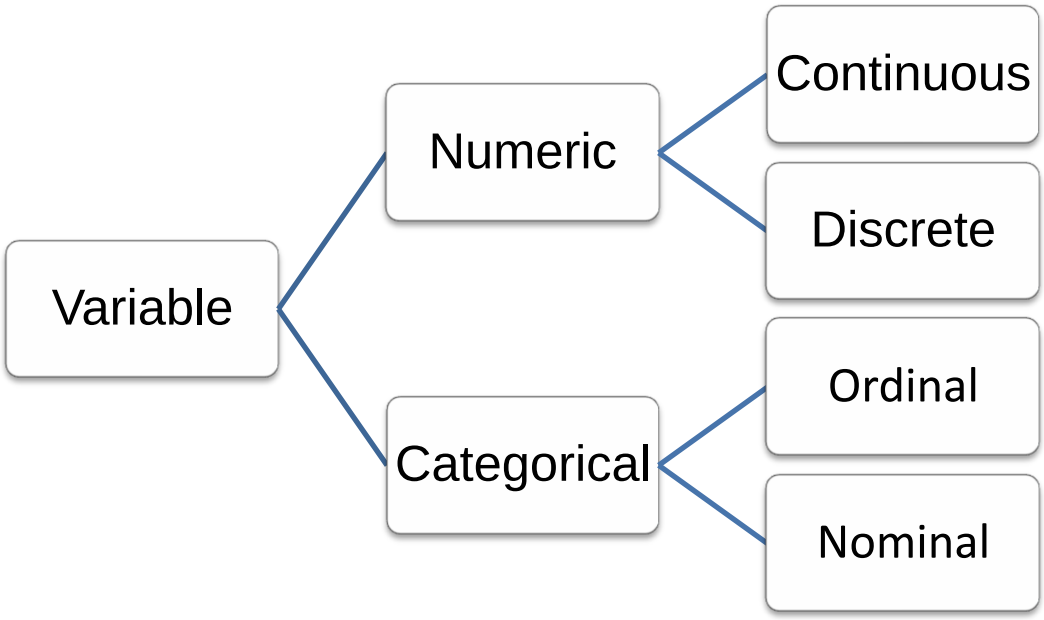
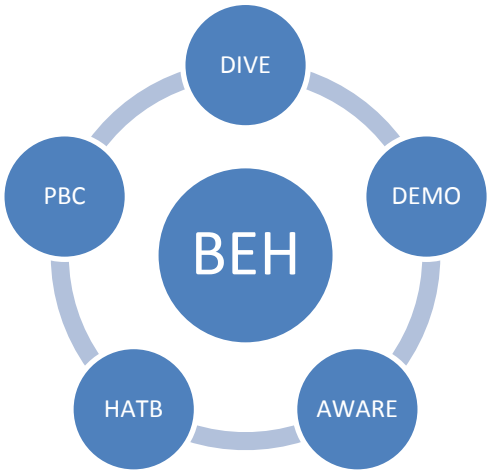


Figure 3.7: Variables description (Mota, 2013).

Ordinal variables are used for describing observations from the Likert-type scale where behaviours are ordered logically from "1 – I don't know, 2 – never do it, to 4 – I always do it", but there is not necessarily any numeric difference between the scales. Another type of categorical variable is a nominal variable, where observations do not require, or do not follow a logical sequence. For example, there is no logical sequence when divers were asked to register their motivation for their trip or when they offered suggestions in the household to reduce marine debris.



There are six variables included in the model for measuring divers' good practices for plastic and food discards in the household. For a clear interpretation of the model and a better understanding of how the variables are connected with the literature review, the variables are described using some of the items listed

Figure 3.8: Variables for modelling (Mota, 2013).

in the tool. To facilitate the process of understanding each variable, which contain statements or questions, practical scenarios are given along with each variable description. This is the descriptive section for each variable used in the proposed model; further details on the question values will be discussed in the next section.

Starting with the first variable being described:

- **(DIVE)** Diving is the nature-base activity which is going to be used for raising environmental awareness among people, in particular scuba divers. Through this activity, divers connect with the underwater world using special equipment to be able to move freely while underwater and observe how life is so prolific and balanced, so close to our eyes. Scuba diving is an activity with the potential for teaching its participants about the importance of species and how much humans depend on marine environments.

  Having already described the population in the study, and illustrated the sampling frame, the instrument is ready to be used for measuring U.S. divers on Cozumel Island. The research aims to characterize divers visiting the reefs by noting which are already certified and what level of certification they have, and also how many dives each has made, which is important to know. The bigger the number of dive, and variety of reefs visited, the greater the experience in scuba diving the participant has. Profiling students requires knowing the type of diving course they took, if they are first timers or already certified divers looking to upgrade their diving skills and knowledge. Cozumel Island receives over 2.5 million tourists per year arriving on cruises (SEDETUR 2012). Many tourists take scuba diving programs as a day experience, and only a few cruise liners offer diving instruction in every port of call. Motivation for visiting Cozumel is recorded in order to profile divers according to their level of engagement in the activity, whether they are on a diving holiday, or if they have another motivation for their visit aside from their diving experience.

  Is important to know how long the divers are staying on the island; however, this measurement is not precise due to the fact that many were

assessed sometime after their arrival. Some would stay a few more days after filling out the survey so the length of stay was registered on a typical timeframe for Cozumel (1 day; 2 to 4 days; 5 to 7 days; more than 7 days). The length of stay on the island is strongly connected with consumption of diving excursions, goods, and amount of currency left on Cozumel Island, which is an important factor that could be used for further studies relating scuba diving to local economic development. Also staying longer on the island offers the chance for increasing the number of sightings of marine debris, and also to observe how local practices are beneficial to or jeopardizing efforts at raising environmental awareness.

The variable DIVE will always depend on experimental values registered in the measurement tool, as the questions listed for measuring DIVE have the purpose of providing information to evaluate the divers' supposed experience and level of expertise. Registering observations for student divers depends on each participant, as beginners could have experienced diving previously without having a diving certification, and also enrolling on the further-education diving courses depends on previous certification level. However, certified divers' registration is independent of their number of dives and level of experience. Therefore, the tool aims at examining whether the mentioned variables produce any change in the dependent variable DIVE. Also the whole variable DIVE assumes a discrete type as it cannot be measured in fractions. Diving certifications are issued after achieving the minimum requirements set by the dive training organization, with no option of 'half-certification'; see for example, the PADI recreational diving course list.

$$\text{Diving certification} = \{SD, OWD, AdvD, AWOD, \ldots MSD\} \quad (3.5)$$

Diving courses are offered by many training agencies and there is a limited number of training programs, being a finite discrete variable. Further, participants can register an infinite number of dives (n), but never a fraction of it. No half dive can be counted, describing an infinite discrete variable.

$$\text{Number of dives} = \{0, 1, 2, 3, 4, 5 \ldots n\} \quad (3.6)$$

- **(DEMO)** Socio-demographic descriptions are required for profiling and represent the sample in the field. For comparative studies in gender, age, education and average household income, the authors mentioned in previous sections provided data for comparison. The study issued by DEMA (2006) offers a good distribution of divers in the U.S., providing the chance to add an updated distribution and making a compare with the existing data. Divers from this case study can be represented geographically in the U.S., allowing a further comparison with social practices in dealing with msw. Also distribution can be compared in order to understand differences between divers' residing in coastal and inland areas.

  Coastal zone definitions vary from country to country, and it was suggested at the UN Conference on Environment and Development in Rio 1992 that countries develop legal instruments for managing coastal areas. This study adopted the definition used in the U.S. Coastal Management Act (1972), which stated that a coastal zone is an area with a population living in counties bordering coastal waters and adjacent shore lands, including beaches, transitional and intertidal areas, salt marshes and other coastal areas such as islands, estuaries and along the Great Lakes.

  Sizing the divers' living area can bring additional information to aid in understanding their current practices, which vary from city to city; when compared with geo-location it can provide interesting data for studying possible interactions in size location. The definition for rural area is currently still under debate, but regarding the fact that the divers in the study are from the U.S., the definition for urban area was taken from the U.S. Title 41 for Public Contracts and Property Management, comprising the Rural Development Act (2009), as amended (7 U.S.C. 2204b-1), defining a rural area as "any area other than: (a) A city or town that has a population of greater than 50,000 inhabitants; and (b) The urbanized area contiguous and adjacent to such a city or town. … furthermore, an urbanized area is a statistical geographic area defined by the Census Bureau, consisting of a central place(s) and adjacent densely settled territory that together contain at least 50,000 people, generally with an overall population density of at least 1,000 people per square mile."

The type of variables describing a diver's socio-demographic profile range from numerical to categorical. In a universe with a positive number of events, participants can be 28 years old, or 28 years and 6 months old; also, household income asked for by the measurement tool can be situated, for example between 22,200.00 and 24,535.32 USD, represented typically by continuous variables and also though dummy variables for statistical analysis. Categorical variables will be used to describe education level, geo-location and the place where the participant lives.

- **(AWARE)** is a variable that can represent quite a lot of predictions, taking into account that the majority of divers are well educated, ranging from those with a school diploma to university studies, being familiar with local environment, geography and courses related to biology (Thailing & Ditton, 2003; Todd, 2004; Grőssling et al., 2004; Musa et al., 2006; Belknap, 2008; Ong & Musa, 2011). In the university system, people are expected to have at least a general awareness of environmental practices. Further, social settlements should carry out the minimum practices for environmental management regarding garbage, water, construction, noise, air pollution, etc.

  Admitting all case scenarios, the described model does not discriminate any diver who has more or less knowledge about environment, good practices or understanding of actual environment-related problems. The model includes "awareness for all" as a required condition to reinforce education, and also because every diving instructor delivers training in different ways. Furthermore, for professionals working on Cozumel Island it is compulsory to attend the environmental training provided by the National Park every four years. Diving professionals need to brief customers before they dive and also alerting divers about good practices and their responsibility when diving in such a protected area. Awareness is constantly delivered in a non-formal environmental education format. For resource management it is imperative to have a contribution from every single person by educating and being educated themselves about sustainability on Cozumel.

Certified divers already observed marine debris while underwater; in many cases boats have poor waste management practices and almost certainly everybody has seen rubbish thrown overboard, be it a plastic bag, paper, cigarette butt, plastic bottle, etc. For raising awareness among divers while on the boat, student divers can become sensitive to the issue of littering at sea by observing how dive schools also struggle with the plastic issue when offering water on board plastic cups are used in order to provide good customer service, plastic wraps are used on the food items served during surface intervals, and many other issues.

It is indeed amazing the amount of waste produced during diving excursions. Some companies started using water refilling stations and encouraging customers to bring their own bottles to refill, which frees up precious space on the boat, saves money and naturally reduces litter in the sea. Yes, scuba diving is very beautiful but it also creates a big impact on nature, for which divers are responsible.

The key question for certified divers concerns behavioural changes they may have gone through since they first started scuba diving. If they have made a positive change then it is interesting to know what exactly has changed, as it would establish a positive relation between scuba diving activity and behavioural changes for minimizing marine debris.

The final aspect for describing the variable “AWARE” recorded by the measurement tool is word of mouth. Participants were asked during the last phase to share their diving experience on Cozumel Island by describing attributes of the Cozumel reef and hopefully mention the high level of environmental education provided by diving professionals. Word of mouth is certainly the best means of promotion for Cozumel and is indirectly a good way to raise awareness among friends.

AWARE is also a categorical variable measured by nominal variables with a finite number of friends with whom the participant can talk about problems related to the environment (question 1.2 from survey 1), and with infinite solutions for when the participant has changed his behaviour due to being a scuba diver and conscious about minimizing their ecological footprint.

- **(HATB)** Household Attitude toward the Behaviour defines divers' attitude toward a specific action to which they are favourable or not through the required behaviour. Questions listed in previous studies were set in the array defined for the variable in the study. Beliefs about the consequences of a specific behaviour confer the ability to measure divers' attitude toward the behaviour.

  The measurement of the latent variable is valued as positive or negative for performing good practices for waste management. For reducing marine debris, divers' *behavioural beliefs* link the behaviour of "adopting good practices for waste management in the household" with "benefits to the environment", which was the expected outcome from that behaviour. This belief is the intellectual expectation of a certain consequence caused by a specific behaviour.

  For example, divers believe that "composting kitchen waste" (behaviour) "reduces municipal solid waste" and so change their discard habits to sending to the landfill only what cannot be composted at home (outcome). Divers' attitude toward behaviour is ruled by their evaluation of the consequence of their behaviour, and how composting kitchen waste influences their decision to behave.

  If "I buy things that are produced with as little packaging as possible", my behaviour toward waste prevention has the outcome of producing less discards, or divers who "prefer paper bags to plastic ones" believe that using plastic bags is seen as a negative for the environment.

  HATB depends on the inputs to the tool when divers register their behaviours along the array of statements listed for HATB; however, all discrete variables have a limited number of choices for answers, which are provided by the Likert-type scale.

- **(PBC)** Perceived Behaviour Control relates divers' beliefs, attitudes, intentions and behaviour**.** Divers' have the intention to perform good practices for waste management in the household as a consequence of a certain attitude created in the past. Divers' must have a perception of whether the behaviour can be performed, and how and when it can be accomplished. The case of "looking for recycling products has become

part of my life" reflects the intention to purchase recycled products, and as result of their ability at performing the behaviour, the individual keeps searching for such products.

Perceived behaviour control is a categorical variable with infinite solutions for performing the routine behaviour of looking for recyclable products. PBC requires intention to perform a successful behaviour, in which a person has the sense of the eventual difficulty level, and is committed to achieving the mission; success is achieved through gaining control of the conditioning factors. PBC brings personal perception of the ability to perform good practices for waste management.

- **(BEH)** Behaviour for good waste management practices regarding plastic and food discards in the divers' household is what is expected to be measured after a long-term four-month impact resulting from a scuba diving experience.

  Scuba diving can assist divers in performing good behaviour when inputs are consistent overtime, such as carrying out a regular diving activity, always having strong and favourable intentions to manage waste accordingly, looking for alternative ways to minimize their ecological footprint and – very important – they need to perceive their ability to perform such behaviour that results in reducing marine debris.

  Behaviour measured through the variables presented in the model confirms that diving activity is a very strong predictor for reducing marine debris, directly linking diving with behavioural change, particularly when supported by environmental education sessions. From the proposed model, behaviour is a dependent categorical variable measured with the presented instrument, and contributes to raising awareness about product consumption and disposal, leading divers to adopt good practices for waste management in their household. Also, the next time they go diving divers will actively look for rubbish on the reef and either pick it up or just report it, and hopefully engage in reef- or beach-cleaning actions for Diving Against Debris.

  Additionally, word of the mouth is an important way to promote environmental awareness among the diver's social circle and the

experience will almost certainly stay alive much longer in the participant's head.

3.2.3.2. Survey to certified divers

For this study, certified divers were assessed with the objective of providing evidence for the typical behaviour of a scuba diver, and to verify if the nature-based activity has any influence on good practices for waste management. Moreover, this group of divers represents a pattern for individuals sharing the same interest in scuba diving, being exposed to the water environment, and "more" aware of marine debris. The survey is composed by seven questions, approaching the variables AWARE, DIVE, HATB, PBC, and DEMO (see appendix A), with the variable BEH given by predictors from quantitative analysis and modelled on the software SPSS 20.

For each variable, the descriptive table provides the value of each question listed in the measurement tool. The statements for creating the variable AWARE (see Table 3.5) can be found in Kaiser's et al. (2003, pp.15, 16) research, in which the author validated 52 behaviours mentioned in the General Ecological Behaviour by using an item response theory model (IRT); 46 out of 52 behaviours were considered valid, including the two questions transposed to this tool (question 1.1 and 1.2).

Question 3.3 was generated by the author of the present thesis, and is a control item to verify if scuba diving is related to behavioural change.

Table 3.5: Statements and questions constituting the variable AWARE.

Environmental awareness (AWARE)			
Question		**Objective**	**Method**
1.1	I am a member of an environmental organization.	Accessing individuals' beliefs and engagement in environmental groups. Eliminate bias.	Question to eliminate bias and to know possible tendency for good waste management practices in the household
1.2	I talk with friends about problems related to the environment.	To know if environment is a common subject for conversation.	Accessing individuals' social interaction and care for the environment.
3.3	Since you started diving, have you changed your behaviour towards the environment in your house?	To know if scuba diving has influenced divers' behaviour.	Accessing what has changed

Source: Mota, 2013.

Based on professional diving experience, the author assembled the questions for measuring the variable DIVE listed in Table 3.6. There is a need to separate certified divers interested in regular diving, independent of their length of stay on the island, and certified divers also interested in acquiring new diving skills, forming then two different groups:

a) Certified divers on regular diving excursions;
b) Certified divers enrolling on further-education diving courses.

Regarding the fact that training agencies offer different levels of training, certified divers looking for advanced or specialty courses must be assessed for behavioural changes. This procedure adds diversity to the sample process for course taking and participation in the three-phase survey. Moreover, divers can be 'recycled' and thereby learn fresh information on environmental education settings and be 'retrained' in marine debris awareness.

Table 3.6: Questions constituting the variable DIVE.

Scuba Diving (DIVE)			
Question		**Objective**	**Method**
2.1	Have you ever tried scuba diving before?	To know if diving students have previous experience in scuba diving.	Making a difference between past experience and new divers.
2.2	What diving courses are you taking?	To know if is an entry-level course or continue-education diving course.	Question for first timers in scuba diving, and individuals who are looking to continue their education.
3.1	What is your certification level?	To know about divers' potential experience.	Official divers' certification level.
3.2	In total, how many dives have you made?	To know divers' underwater experience.	Dives logged since their first experience.

Source: Mota, 2013.

Registering personal attitudes of actual behaviour in the household that prevents marine debris, has required sampling questions from three different scientific papers, revealing outcomes for behaviour toward waste prevention (Bortoleto et al., 2012, pp. 2198,2199), pro-environmental behaviour (Rodríguez-Barreiro et al., 2012, p.8; Miao & Wei, 2013, p.106), and when comparing typical behaviour in the household and in a hotel setting. Also, a statement for ecological behaviour (Kaiser et al, 2003, pp. 15,16) is included in this array for measuring household attitude toward behaviour (see Table 3.7).

Table 3.7: Array of statements constituting the variable HATB.

Household Attitude Toward the Behaviour (HATB)			
Question		**Objective**	**Method**
4.1	I buy things that are produced with as little packaging as possible.	Identify the behaviour for volume packaging and plastic.	Explanatory beliefs which are readily accessible from memory.
4.2	I use my own bag when going shopping, rather than one provided by the shop.	Identify the behaviour for the use of paper/plastic bags.	Explanatory beliefs which are readily accessible from memory.
4.3	I buy fruit and vegetables without package.	Identify the behaviour for volume packaging and plastic.	Explanatory beliefs which are readily accessible from memory.
4.4	I compost my kitchen waste.	Identify the behaviour for disposing food waste and food waste prevention programs.	Explanatory beliefs which are readily accessible in memory.
4.5	When shopping, I access the type of packaging and choose one that is recyclable.	Identify the behaviour for purchasing recyclable products.	Explanatory belief which are readily accessible in memory.
4.6	I purchase organic food.	Identifying behaviour for food purchase.	Explanatory beliefs which are readily accessible in memory.
4.7	I purchase bio-degradable products.	Identify the behaviour for environmental waste disposal.	Explanatory beliefs which are readily accessible in memory.
4.8	I look for ways to reuse things.	Identify the behaviour for reusing materials.	Explanatory beliefs which are readily accessible in memory.
4.9	I recycle materials like newspapers, cans and bottles.	Identify environmental behaviour and responsible waste management practice.	Explanatory beliefs which are readily accessible in memory.
4.10	For shopping, I prefer paper bags to plastic	Identify the behaviour for the use of plastic.	Explanatory beliefs which are readily accessible in

	ones.		memory.
4.11	I buy seasonal produce.	Identify the behaviour for plastic-related products in food networks, and resource saving in transport and losses associated with fresh products.	Explanatory beliefs which are readily accessible in memory.

Source: Mota, 2013.

For example, when divers' say "I buy seasonal produce" (question 4.11), it demonstrates behavioural belief linked with the related outcome of saving energy and packaging for transportation. Furthermore, purchasing seasonal produce activates the local food chain, minimising losses.

Some study questions were tested on a different population as they were designed to fit in a merged model containing the theory of planned behaviour. Bortoleto et al. (2012, pp. 2198, 2199) concluded that perceived behaviour control can be a good predictor for waste prevention behaviour, but subjective norms have little influence. Question "5.1 – Most people I know contribute to help the environment" has the function to identify social relationships and norms to which the individual is subjected. It is a simple control question to try to understand the individuals' beliefs about what other people expect from him; however, if this is not contemplated in the model it has the purpose to verify using cluster analyses, if it could be included in the model setting.

Table 3.8: Statement constituting the variable PBC.

Perceived Behaviour Control (PBC)			
Question		**Objective**	**Method**
5.2	Looking for recyclable products has become part of my life.	Evaluate environmental perception as a consequence of divers' decision to perform the behaviour.	Beliefs about factors that may regulate their performance behaviour.

Source: Mota, 2013.

In Table 3.8, when divers respond in affirmatively and demonstrate their intention to 'look for recycling products', they perceive their ability to perform a regular behaviour and thus make a contribution to minimizing impacts on the environment.

The variable DEMO described on Table 3.9 draws the profile for each participant and carries important value for updating the world's diving information and for associating potential behaviours to regional areas in the U.S. The variable also retains vital information for confirming the participants' nationality.

Table 3.9: Questions constituting the variable DEMO.

Socio-Demographic (DEMO)			
Question		**Objective**	**Method**
6.1	In which part of the country do you live?	Describing regional distribution and possible patterns for household solid waste management.	Description of living area.
6.2	How would you describe where you live?	Sizing diver's living area	Sizing the residential area.
6.3	What is your motivation for your trip?	Knowledge about the reason why the tourist is on Cozumel Island.	Individuals' motivation for traveling.
6.4	Please write your age.	Description of the population in the study.	Minimum age is 18 years old.
6.5	Gender.	Description of the population in the study.	Inquiring male and female.
6.6	Please indicate your education level.	Describe divers' education level.	Multiple choices.
6.7	What is your annual household income in USD?	Divers' profile	Signaling annual income on a bracket scale.
7	The last phase of the study will be done online. Would you like to participate?	Participation in the long-term impact survey.	Using email or social networks.

7.1	Name and Surname.	For emailing the 4 months survey, by making it more personal.	Personal writing.
7.2	Email.	For emailing the post-questionnaire.	Email use.
7.3	Home address.	Confirming nationality and geo-location.	Personal handwriting.

Source: Mota, 2013.

3.2.3.3. Survey to student divers

The second phase survey is directed to diving students enjoying the reefs of Cozumel, starting with one indirect question aimed at finding out approximately how much time divers spend on the island (see Table 3.10; appendix A; appendix B). Cozumel is a well-known destination for scuba diving and tourists arrive by cruise, ferry boat, or stay in hotels. The island offers a wide variety of water-based activities, with scuba diving one of the most popular (Jiménez et al., 2005, p. 56) after shopping, and followed by snorkelling. Both activities take place directly in the sea where visitors have a better chance of observing marine debris.

Table 3.10: Question constituting the variable DIVE.

		Diving (DIVE)	
Question		**Objective**	**Method**
1	In total, how long are you staying on Cozumel Island?	Time spent diving on Cozumel.	Access contact time with the Cozumel reef

Source: Mota, 2013.

It is very important to measure the participants' level of satisfaction during the diving course. Past professional experiences revealed happiness to be a strong predictor for enhancing post-diving awareness, with students raving about their amazing experience, sharing it with relatives and friends, and showing engagement in scuba diving activity. Divers and snorkelers are "the natural

ambassadors for the aquatic environment" (PADI, 2005, p.6). The opposite situation could occur following a non-successful experience on the diving course; stress factors mixed with the participant's reduced in-water skills obstructed diving performance and hindered enjoyment. Also noticed was the tendency to avoid talking about diving-related subjects, and a lack of interested in committing to pro-environmental behaviours related to the sea (see Table 3.11).

In this survey, participants could register a sighting of marine debris, demonstrating the ability to identify such threats in the marine environment. Also Kaiser et al. (2003, pp.16) contributed with one question for assessing divers' ecological behaviour and environmental awareness by talking about environmental problems while on Cozumel Island.

Environmental awareness can be described as when participants understand "what benefits . . . communities have from living near coral reef areas", showing comprehension of the importance of coral for the whole ecosystem. Corals not only benefit marine species, but also function as a protective barrier against storms and erosion caused by wave movements, as coral reefs absorb wave energy. Tourism activity develops near coral reef areas, which boosts local economies by sustaining employment and developing tourist attractions.

Table 3.11: Questions constituting the variable AWARE.

Environmental Awareness (AWARE)			
Question		**Objective**	**Method**
2	Did you enjoy your diving course on Cozumel Island?	Emotional level connected to behaviour intention.	Accessing emotions through the diving course.
3	During your excursion to the dive sites, did you notice any marine debris?	Connection with the surrounding environment and perception of marine debris.	Registering details from diving trip to the dive site and diving experience.
5	During your visit to Cozumel, did you ever talk to anyone about environmental problems?	Looking for environmental engagement and discussion.	Social talk among divers and friends.
6	What benefits do	Learning during the diving	Accessing individuals'

	communities have from living near coral reef areas?	experience and talks with the diving instructor.	sense of responsibility.

Source: Mota, 2013.

While on Cozumel Island, participants were relaxed and displayed their consumption behaviour by registering the amount of plastic and food-related items purchased for consumption. All items listed in Table 3.12 are commonly found among marine debris an collected during beach-cleaning actions, and also listed in the Dive Against Debris guide from Project AWARE.

The consumption of goods registered in Table 3.12 is also a reflex from diver's behaviour in their household and, moreover, constitutes the main body of local municipal solid waste. Further research can be conducted to study, for example, the amount of waste generated by tourists visiting Cozumel Island, and how much capacity the island has to absorb it.

Table 3.12: List of items consumed while on Cozumel Island, variable HATB.

Household Attitude Toward the Behaviour (HATB)			
Question		**Objective**	**Method**
Please signal how much of these materials you have consumed while staying on Cozumel island:		To trigger the individuals' conscience about waste production and management.	Recalling materials purchased on the island or used during the visit.
4.1	Plastic bags.	Connecting to daily routine.	Recalling materials purchased on the island or used during the visit.
4.2	Plastic cups.	To trigger the individuals' conscience about plastic usage.	Recalling materials purchased on the island or used during the visit.
4.3	Styrofoam cups.	To trigger the individuals' conscience about plastic-derivative usage.	Recalling materials purchased on the island or used during the visit.
4.4	Packages of	Connecting to daily routine	Recalling materials

	cigarettes.	and triggering the individuals' conscience about plastic waste.	purchased on the island or used during the visit.
4.5	Food containers.	To trigger the individuals' conscience about plastic and food disposal.	Recalling materials purchased on the island or used during the visit.
4.6	Plastic bottles.	To trigger the individuals' conscience about plastic waste.	Recalling materials purchased on the island or used during the visit.
4.7	Drinking straws.	To trigger the individuals' conscience about plastic waste.	Recalling materials purchased on the island or used during the visit.
4.8	Beer bottles.	To access individuals' perception of waste value.	Recalling materials purchased on the island or used during the visit.
4.9	Batteries – AA, AAA, C&D, 6V, 9V, etc.	Trigger the individuals' conscience for chemical waste.	Recalling materials purchased on the island or used during the visit.
4.10	Other:	Registering items not listed above.	Recalling materials purchased on the island or used during the visit.

Source: Source: Mota, 2013.

After completing a diving experience and being learning about local environmental issues, divers become more aware of possible actions to take for reducing marine debris. The perceived behaviour control shows the level of commitment and the strong will to change their behaviour in their household. Based on divers' direct observation of marine debris, and as a good predictor for waste prevention behaviour, suggestions can be registered in question 7 (see Table 3.13).

Table 3.13: Suggestions for reducing marine debris by PBC.

Perceived Behaviour Control (PBC)			
Question		**Objective**	**Method**
7	In order to reduce marine debris, what would you suggest to change in your household?	Accessing if the experience has triggered any sense of responsibility and future behaviour intention.	Divers' experience on Cozumel.

Source: Mota, 2013.

To keep tracking of participants, demographic aspects were again registered using the same set of questions from the previous survey. Also, in some cases student divers could register their observations when were first assessed when enrolling on the course and again after completing their training.

3.2.3.4. Survey for long-term impact on divers' behaviour in the household

Table 3.14: Items for controlling participants in a long-term impact study.

Web Survey Control			
Question		**Objective**	**Method**
1	Please insert your code number:	To study the same the participant along the 3-phase study.	Survey code number.
2	Your name is:	Confirming that is the same participant.	Name needs to match with previous surveys.

Source: Mota, 2013.

Launched four months after the participants' diving experience on Cozumel Island, the web survey registered qualitative responses for long-term impact on divers' behaviour in the household (see appendix C). After this long period of time, participants received a private email expressing of gratitude for their earlier participation and inviting them to be part of the last phase of the

study. The email included the link to the survey and a code number matching with the serial number assigned in previous phases to each individual (see Table 3.14).

The long-term impact is measured through a series of control questions (see Table 3.15) and suggestions for behaviour after concluding a diving experience. After their holiday it is expected for divers to recount facts that reveal some deviation from their daily routine.

Table 3.15: Behaviour registered four to six months after the experience.

Long-term Impact Behaviour (BEH)			
Question		**Objective**	**Method**
1	Since you returned from your diving trip to Cozumel, have you shared your experience with anyone?	Control "AWARE" by accessing individuals' social interaction and care for the environment. Access if the individual shares his experience.	Crossing data for the variable AWARE from survey 1 (questions 1.1 and 1.2) and survey 2 (questions 2, 3, 5 and 6).
2	Since you have taken your very first dive ever, in what way have you changed your behaviour towards the environment in your household?	Control "AWARE" by confirming previous information. Confirming "PBC" suggestions for care for the environment in survey 2 question 7.	Crossing data with variable AWARE in survey 1 (question 3.3), and survey 2 (questions 2, 3, 5 and 6).
3	What types of materials do your recycle?	Test if the experience has triggered any changes to the "HATB". Second control of the suggestions from PBC survey 2 (question 7)	Crossing data with variable HATB from previous surveys, and variable PBC from survey 1(question 5.2), and survey 2 (question 7).

Source: Mota, 2013.

Through question 1, spreading the word for environmental protection verifies the sharing feelings and observations from the diving experience.

Crossing data from previous phases can also verify pro-environmental behaviour, for example, by registering for membership of environmental organizations, which divers can feel more included to do. Also talking with friends about environmental problems, in particular marine debris, can be an indication that scuba diving is a strong predictor for environmental awareness and pro-environmental behaviour.

Certified divers, who answered affirmatively to question 3.3 in survey 1, were asked to give their description for behavioural change influenced by scuba diving. The registry signals the importance given to the marine environment, and how strong scuba diving can influence people in making them changing their environmental practices.

Behaviour in the household is also controlled by listing the type of materials recycled in the household; the control check is ruled by the HATB and PBC registered in previous phases, which can be enhanced after the scuba diving activity and provided environmental session.

The behavioural change listed in question 4, is now controlled through the use of the question 4, from survey 1, for household attitude toward the behaviour (Table 3.7). Eventual changes might indicate that observing marine life, together with environmental sessions, can be a predictor for behavioural change. The array of statements listed in this question, is the same from the entry survey, controlling the same answers from before, looking now for eventual changes. Participants, who have become more sensitive to the issue of marine debris, have now the chance to register their behaviour in their household, for reducing food waste and plastic-related products in their routine lives.

Also, the HATB listed in Table 3.16 is cross-checked with five questions listed in survey 2 (questions 4.1 to 4.6 from survey 2 – Table 3.12) supported by the Dive Against Debris guidelines, and four newly added questions (5.2, 5.7 to 5.9) supported by the NRDC. The questions refer to products which are part of normal food items for U.S. families, such as yogurt or fruit; furthermore, the questions ask about for daily discards of over-prepared food and also rotten food items. This cross-check looks for environmental awareness produced from product consumption while on Cozumel Island, and possible outcomes from marine debris observed during the diving experience.

Table 3.16: Controlling HATB for potential daily discards.

Household Attitude Toward Behaviour (HATB) - Control			
Question		**Objective**	**Method**
Please circle the amount of materials disposed of daily in your house:		To access the individuals' behaviour in solid waste management and food disposal.	Comparing attitude values answered in survey 2 (question 4).
5.1	Plastic bags.	Access the amount of plastic disposed of daily.	Comparing attitude values answered in survey 2 (question 4).
5.2	Yogurt plastic cups.	Access the amount of plastic disposed of daily.	Comparing attitude values answered in survey 2 (question 4).
5.3	Food containers.	Access the amount of plastic disposed of daily.	Comparing attitude values answered in survey 2 (question 4).
5.4	Plastic bottles.	Access the amount of plastic disposed of daily.	Comparing attitude values answered in survey 2 (question 4).
5.5	Drinking straws.	Access the amount of plastic disposed of daily.	Comparing attitude values answered in survey 2 (question 4).
5.6	Beer bottles.	Access the amount of plastic or glass disposed of daily.	Comparing attitude values answered in survey 2 (question 4).
5.7	Rotten food.	Access the amount of food leftovers or bulk purchases disposed of daily.	Relating attitude values answered in survey 2 (question 4).
5.8	Fruit	Access the amount of food leftover disposed of daily.	Relating attitude values answered in survey 2 (question 4).
5.9	Prepared food	Access the amount of food leftovers disposed of daily.	Relating attitude values answered in survey 2 (question 4).

Source: Mota, 2013.

The perceived behaviour control listed in questions 6 and 7 (Table 3.17), aims to determine good environmental practices and what type of behaviour the diver has in their household. In the previous survey the participant was simply asked to answer a statement about seeking out recyclable products, and they now had the chance to list some of those products for verification of their intention to perform the behaviour and the achievement of recycling products in

their daily routine. The question provided by Bortoleto et al. (2012, p. 2199) was rephrased for the cross-check; it can also provide relevant information for the case of a diver previously not being interested in looking for recyclable products, but who is now showing different intentions to perform the behaviour.

Table 3.17: Controlling PBC on long-term impact study.

Perceived Behaviour Control (PBC) - Control			
Question		**Objective**	**Method**
6	What type of goods do you look to recycle in your daily routine?	Confirm good practices and to know what products are recycled.	To cross data with the variable "PBC" from questionnaire 1 (question 5.2).
7	Since you have returned from Cozumel what did you change in your household?	Description of behaviour changes in the household.	To cross data with the variable "PBC" from questionnaire 2.

Source: Mota, 2013.

The web survey included demographic variables like the ones listed below in Table 3.18. Once again crossing information is very important to grant handling the different phases from each participant and also to re-confirm their geo-location.

In resume, behaviour (BEH) was controlled using some questions from previous phases, using perceived behaviour control by having divers list what products actually motivated them to recycle, and what behaviours can be achieved from their suggestions and non-formal environmental education sessions.

Table 3.18: Items for controlling divers' geo-distribution.

Socio-Demographic (DEMO) - Control			
	Question	**Objective**	**Method**
8	Which country do you live in?	Minimize possible author's error in analyzing the survey, matching the target population	Confirming with previous survey
9	Please write the name of the city you live in:	To describe the geographical distribution in the U.S.	City name needs to match with information in previous surveys. Geo-coding is required.
10	Please write any comments below:	Collect impressions from participants regarding the study.	Option question about the last phase of the study.

Source: Mota, 2013.

Relevant observations could be noted from the web survey where participants showed an intention to act or reported a willingness to perform the behaviour, as were validated by research conducted previously (see: Armitage & Conner, 2001; Bamberg & Schmidt, 2003; Webb & Sheeran, 2006; Bamberg & Möser, 2007; or Rivis et al., 2009, in Rodríguez-Barreiro et al., 2012). Intention was revealed to be a strong predictor for behaviour. Other authors (e.g., Stern, 2000; Lin & Huang, 2012) reported emotional involvement from past experiences as developing the individual's environmental consciousness. Like in the proposed model, sighting marine debris and environmental education formats can influence future decisions for performing behaviour and develop environmental consciousness.

Stern discussed environmental behaviours and their significant definitions, bridging environmental concern and behaviour, and highlighted the need to change human behaviours due to the impacts created that result in environmental problems.

In the household, people have the freedom to choose what behaviour to adopt, but always based on their beliefs regarding the consumption of goods important for filling their needs. The context in which people are involved plays an important role in understanding the reasons certain behaviour is performed

(Stern, 2000). For example, active divers showed a clear tendency to respect and follow guidelines to avoid disturbing marine life, the value attached to their action is reflected in their behaviour, and advise other divers to behave accordingly. The routine of eating local products served fresh on the table, made divers understand the value of contributing to local development while meeting their own needs.

When the message passes across, divers can carry the responsibility to behave pro-environmentally in their daily life.

3.2.3.5. Analysing reliability by using Cronbach's Alpha on Likert scales

Rensis Likert[7] (1903) influenced the whole of the scientific community by developing his technique for measuring attitudes or certain objects, which is commonly used in surveys for registering participants' observation. In his doctoral thesis, published in 1932, the "Likert scale" developed for measuring attitudes explains Likert's pragmatic way of approaching engineering problems through the use of a 5-point scale, which provided similar statistical results compared to traditional methods (Kish, 1990, p.36). As an example, observations related to attitudes, emotions, opinions and perceptions can be registered using a Likert-type scale. The scale can be used for measuring personal perception, attitude or performance, arranged from the less favourable to the more favourable answer within a certain rank, and unfavourable answers always tend to occupy the lower rank (Gliem& Gliem, 2003).

Liker scales can be described as follows:

"A set of items, composed of approximately an equal number of favourable and unfavourable statements concerning the attitude object, is given to a group of subjects. They are asked to respond to each statement in terms of their own degree of agreement or disagreement. Typically, they are instructed to select one of five responses: strongly agree, agree, undecided, disagree, or

[7] Rensis Likert (1903 - 1981) A typical Likert-like scale: " I find these guides to be useful:"
Always _____ Almost_____ Sometimes_____ Almost Never_____ Never_____
Source: http://www.lib.uwo.ca/programs/generalbusiness/likert.html

strongly disagree. The specific responses to the items are combined so that individuals with the most favourable attitudes will have the highest scores while individuals with the least favourable (or unfavourable) attitudes will have the lowest scores. While not all summated scales are created according to Likert's specific procedures, all such scales share the basic logic associated with Likert scaling" (McIver & Carmines, 1981, pp. 22-23).

Summated scales, associated with Likert scales, were studied by Spector (1992), who defined four important characteristics, the first being a requirement for scales to be populated with multiple items. To be viable, the second characteristic states the need for individual items to measure important constructs; the sum of quantitative measurements can also represent qualitative data as an attitude, for example, can vary from the unfavourable answer "I don't know" or "I never do it", to the most favourable answer "I do it often". The third characteristic does not have a "right answer", differing from multiple-choice tests; and fourth, items forming the scale are statements to which participants are asked to register using only one scale value for each statement (Spector, 1992; Gliem & Gliem, 2003).

Measuring psychological attributes generated further discussion about using multi-item measures and not single-item measures instead. Findings revealed random errors as being significant for measurements, making them unreliable as they could be imprecise when measuring two different levels of an attribute: "individual items can only categorize people into a relatively small number of groups" (Gliem & Gliem, 2003, p.83) and single items are definitely not sufficient for describing the complexity of any particular attribute (see: McIver & Carmines, 1981; Spector, 1992; Nunnally & Bernstein, 1994).

Warmbrod (2001) analysed several scientific papers where Likert-type scales were used and measurements for internal consistency and reliability were made using Cronbach's alpha, but also a single-item analysis was performed, which has a low level of reliability. Predicting components in objective models requires reliable variables with a scale used for measuring observations; moreover, it is important to know if items show consistency when re-administered to the same participants. Variables tested for reliability can be declared fit and reliable only when submitted to a test function (Santos, 1999).

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Tests and questionnaires attempt to be reliable and valid, being concerned with the ability to perform consistent measurements and what is exactly being measured. Only reliable instruments can provide valid data; however, their reliability does not depend on their validity. When developing instruments with multi-item measures they should always be tested for reliability, which is commonly carried out using Cronbach's alpha.

Cronbach's alpha tests reliability by measuring the average value of the given reliability for all possible combinations when using a split half method. Lee Cronbach[8] (1951) developed internal consistency by measuring or testing the scale in use by expressing a number between 0 and 1 whereby items testing the construct can provide the level of inter-relationship among them. Testing such inter-relationship guaranties the test score by producing an index of a measurement error when testing itself (Tavakol & Dennick, 2011).

George and Malley (2003) provided an interpretation for the value:

Cronbach's alpha
- > 0.9 – Excellent.
- > 0.8 – Good.
- > 0.7 – Acceptable.
- > 0.6 – Questionable.
- > 0.5 – Poor.
- < 0.5 – Unacceptable.

(George & Mallery, 2003, p.231).

The number of items present in the scale has an influence on the alpha value, and the value 0.8 is a reasonable target to achieve. When assembling the scale with respective statements to measure, an alpha range from 0.7 to 0.95 should be targeted, where low values are usually related with a low number of questions. This verifies the importance of multi-item measurements or the poor inter-relation between items. Cronbach's alpha is a numeric value describing reliability and provides an index associated to the variation between the hypothetical "true score" and the construct being measured. When the index has a low value, individual statements associated to that index must be reviewed or modified in order to increase its reliability.

[8]Lee Cronbach made major contributions in the fields of educational psychology, psychological testing and program evaluation. Source: http://histsoc.stanford.edu/pdfmem/CronbachL.pdf

3.3. Interviews to diving professionals on Cozumel Island

For the closure of the Ph.D. research fieldwork for diving tourism conducted on Cozumel Island, a semi-structured interview was developed to be administered to professional divers working on Cozumel (see appendix H). This instrument provides a better understanding of the population in the study and its behaviour towards the environment. After observing how professionals delivered the environmental education session, the interview aimed to catch the opinion of diving professionals involved in the diving scene. The questions were focused on convenient means of disseminating environmental education on Cozumel Island and divers' environmental conscience related with the opportunity to act by reducing marine debris.

The data obtained from the interview contributed qualitative observations of the whole diving scene, and to understanding Cozumel Reef as one of the most well-known diving grounds in the Caribbean. Besides the measurement tool being more focused on diving students, there was an important need to understand divers visiting Cozumel Reef National Park in order to build references for typical divers' behaviour during fieldwork.

The professionals involved in this assessment had varied levels of experience, ranging from four to twenty five years working on the island, but always related to diving. Their nationalities also varied, suggesting probable different perceptions about customer service and environmental issues. Information provided during the interview was always focused on general environmental problems affecting the island, especially the marine debris, which is carried by the current and deposited on the Cozumel shoreline, by sometimes settling on the seabed. The 20-minute interviews took place at four different diving schools, operated by two Mexicans, one Canadian and one Italian on 11st and 12nd April, 2013. All managers worked with different nationalities, which might reflect a curiosity, or lack of, for certain aspects regarding marine debris and divers' behaviour as a threat to the Cozumel reefs.

Professionals were questioned about current Cozumel environmental problems and how they could relate to the reef. Some offered quite negative scenarios, which was more related to the local attitude of disposing of garbage in the street. Tourists behave quite well, adopting a better attitude as they are guests and try to behave well. Tourists do not affect the reef much with direct

pollution of it, but they are the major contributor to reef degradation through poor buoyancy control or when they fail to follow good diving practices. This signals an opportunity for diving instructors and guides to play an important role when teaching dive visitors, as it is essential for beginners to have a good mentor and role model.

Cozumel Island hosts all kinds of people; the majority of tourists arriving on the island are from the U.S. and they demonstrate good attitudes regarding littering and following the diving instructors' advice. Another Mexican professional mentioned the responsibility for teaching people responsible behaviour, both underwater and out of it. For some operators, environmental problems on Cozumel stem from people not being taught well and then going diving anywhere and causing a lot of damage to the reef due to bad buoyancy control and by using underwater cameras to photograph it. Education and good diving practices, buoyancy control and not disturbing the seabed are the basic fundaments for keeping the reef healthy.

Perhaps one of the major environmental problems is the coastal development on the southern part of the island, along the coast bordering the Marine Park, and the waste water management practices of all the hotels, restaurants and condominiums. Of course, scuba divers also impact the coral reef, but it is important to mention the governmental practices and solutions in Mexico for waste water treatment. The dolphinarium and the animals that are now popular to be kept in captivity like dolphins, rays and seas lions produce lots of excrement, releasing bacteria and nutrients into the water.

Simultaneously, there is the permanent stress caused by natural phenomena like hurricanes affecting Cozumel. It was reported by the oldest operator that until a few years ago, the reef was able to recover much faster from hurricanes due to being exposed to less stress, but now with increased stress factors, it takes longer. With 25 years' working on Cozumel, the same diving professional felt "blessed with this island and for the coral reef being capable to handle so much abuse". After Hurricane Wilma (October 21st 2005) the reef took a long time to recover, and in 2013 it was almost as good as it had been before and the difference could barely be noticed. However, he also remembered that after the Hurricane Gilberto (September 14th 1988), the reef has recovered within 3 years due to it being exposed to a lower level of stress.

Reports from the local operators highlighted the urgent need for local environmental awareness to stop the local population from littering and to be more active in garbage separation; they had been seen throwing out trash anywhere. Grocery and potato-chip bags always end up in the water, and constantly divers have to pick garbage and collect bottles, beer caps and soda from the reef. With so many divers around it is common practice to pick up litter from the bottom.

Apparently, littering is most seen at areas near the shore, as diving operators did not see that much garbage on the reef itself, probably because of the current passing through the channel, causing a venturi effect and increasing its speed, and cleaning the reef in the process.

On Cozumel, every local diver is proud of the coral reef, as it provides a living for the island by supporting tourism activity. This compels them to always clean up the reef, especially because of the environmental education they were provided by the PNAC. They know what a polyp is and that it can be suffocated by a plastic bag or bottle, or even that a turtle can eat plastic by mistaking for a jelly fish. In general, Cozumel is a clean city which is verified by generally how clean its underwater areas are.

The environmental training provided by the PNAC was revealed to be very important for customer education about diving practices on the reef. Operators agree with the importance of such environmental orientation for diving students, who have no experience in the open water, and how they should use their instructors as role models. Dive guides brief their customers about procedures and how to interact in the water, especially that they should not disturb the marine life. When tourists arrive for scuba diving, operators introduce them to the PNAC, as oftentimes tourists do not know what a marine protected area is, which requires detailed information being given to them about rules, codes of conduct and diving procedures.

Twice a month, local groups are organized for beach and reef clean-ups, and tourists can also get involved, which they would almost certainly be happy to do, but operators mentioned the lack of promotion for the activity. With some time spent doing this sort of action, tourists can feel more involved and that they are contributing to making the island a cleaner place, but it is important to invite them to participate. Tourism providers feel responsible for

getting the whole community involved in environmental awareness activities, in particular for clean-ups actions.

Some groups traveling to Cozumel Island started sponsoring beach clean-ups, which is a really good thing. Also some tourists choose to visit the destination for relaxation and not to get involved in any of these cleaning actions, although the foreign younger generation visiting the island is keen to participate through the university activity program, which is run every year.

Size matters on diving boats offering food and drinks on board, as they offer water bottles, soft drinks, plastic cups, food service with food wrapping and plastic bags. Sometimes groups of divers request specific on-board catering, sometimes with a plastic-free service, and others special drinks or fruit. Dive operators, who are dependent on big boats to get to the reef, feel restricted in how they can influence practices onboard, while others prefer to handle the issue by spending their surface interval at a shore-side beach club, where divers can relax, access catering services and use the toilet.

Already many people started making comments about the amount of plastic bottles being thrown way every day on the boat. They suggested some alternatives such as using a big gallon bottle onboard from which divers can refill their cups. However, on Cozumel there are people who make a living from collecting plastic bottles for reusing or recycling and can get up to 7 or 8 MXN pesos per kilogram, and also there are many companies that make money from trading waste.

It is becoming common for some divers and diving staff to carry their own refilling bottle to the diving boats, showing some responsibility in minimizing waste by refilling from the big on-board coolers. However, on-board customer service requires traditional items such as plastic cups, which some tourist providers have shown an interest in omitting from operation and substituting them with refill bottles, which offers them the opportunity to sell souvenirs in the freed-up space. On some occasions, people bring their own Tupperware, reuse drinking bottles or bring their own glass bottles to prevent contamination. A belief was noted that if the population starts rejecting plastic for reusable glass containers, big companies would be forced to change their policies and adapt their products to the new demand, and thus reduce plastic production.

Marine debris, in particular plastic, comes from the garbage left in the few trash bins to be found on the streets of Cozumel, which gets blown away when the north wind is strong, littering the sea. On Cozumel, dive operators try their best to keep the place clean by adopting good environmental practices, whereas visitors are more focused on cultural and leisure activities during their stay on the island. Some suggestions were placed on the table for dealing with the problem and all operators agreed that education forms the basis of good behaviour and environmental practices, in particular those regarding waste production and management. They aim at appealing to peoples' conscience so they use the litter bins, and even when they are not available on the streets, tourists and locals can always enter any business and asking to dispose of their discards there. This definitely seems a good option and an acceptable practice, and much better than littering the area.

The world cannot be changed in one go or by one person; there is a need to share beliefs and attitudes. Probably if we change ourselves first, by changing the way we think and act, we can raise awareness. Moreover, one of the operators commented that we can be an example to others, which is the way to teach people.

Another suggestion was to educate visitors to change their minds about available drinking water on the island. There are alternatives to the single-use drinking bottle; visitors mistakenly believe that they are not supposed to drink water refilled from the gallon jug and ask for a sealed bottle as they believe the water is not safe for drinking, having been refilled from the tap. Thus, Cozumel goes through a lot of unnecessary plastic bottles when a bit more education for the tourist about the availability of cheap drinking water on the island would avoid the need to constantly buy all of these little plastic bottles. Before boarding the diving boats, divers should be told to bring their own bottles and that water is definitely available. If customers bring their own bottles, which are usually plastic, aluminium or a thermos type, they can get refilled, which would reduce a lot of plastic waste onboard, but there is also the issue of using plastic which we want to avoid.

The approaches in this interview were only representative of the professionals assessed, but a reflex from common behaviour for environmental education and practices. The PNAC tries to control the Marine Park and

operational procedures, and also provides regular training courses for professionals and assistance to tourism providers.

3.4. Challenges of doing fieldwork on Cozumel Island

Fieldwork is one of the more important parts of the research, where data collection takes place and technical challenges are most likely to arise. The title of this thesis suggests the use of a diving ground where divers can be approached, and moreover where the population in the study is more frequently to be found on their diving holiday. At the beginning people might try to find the relation between the fieldwork location and population in the study, and ask why the waste management behaviours and practices of U.S. divers in Mexico should be studied after they have returned to their homes in the U.S. A very simple way to answer this is creativity; researchers must be creative and innovate the way fieldwork is carried out. Also, the focus is on tourists because Miao and Wei (2013) found differences in pro-environmental behaviours between household and hotel settings. In the latter there is someone whose job it is to serve guest needs, who is paid to take care of garbage separation, recycling and disposal. So, having scuba diving as a common activity for U.S. diving tourists and fieldwork research, was found as the best option for reaching such population target. Also during holiday, and while performing a nature-based activity, the research aims to raise environmental awareness among divers.

The universities involved in the research (the University of Santiago Compostela in Spain, and the University of Quintana Roo in Cozumel, Mexico) provided important institutional support for setting up an objective fieldwork program. Access to literature, facilities and the research group on Cozumel were crucial for the development of this thesis. Coordination and cognitive support was contributed for fieldwork methodology, and for designing a reliable measurement tool. The development of such an instrument turned out to be demanding in terms of achieving good reliability and validity, which influenced the whole research project. The measurement tool is just an instrument for registering regular fieldwork observations (see appendix A, B, and C), although it

is very important to adapt it to the actual needs of specific objectives and for testing the hypothesis.

Visiting the extensive list of scuba diving schools and dive centres on Cozumel Island allowed the opportunity to personally meet some of the operational managers and owners of each business. Due to the fact that many schools were registered on the mainland and not the island, with their Cozumel presence more of a booking office, it was decided to approach only PADI dive centres and diving schools. The measurement tool aims to measure student divers, and shows more reliability if used on professional businesses where training standards are supposed to be followed. At the time the fieldwork was initiated, PADI was the international diving organization most represented on the island with twenty seven registered businesses, followed by SSI; however, there were more than 75 diving business operating under the Cozumel Association for Diving Operators. A list of registered business was requested but never provided, so for research purposes only those mentioned on the PADI website were used for sampling. There is stiff competition for diving business, and apparently diving businesses open and close almost every other week.

On behalf of the universities involved in the research, the introductory procedure has started by asking for collaboration and permission to assess diving customers. Due to being an international researcher and not knowing anyone on the island made fieldwork much more challenging, as language barriers had the to be overcome so using clear speech was very important for obtaining collaboration. In some cases managers were not interested in participating in the study, and sometimes people were afraid of the supposed hidden intentions of the research; some company policies did not allow the collection of personal information from divers, which affected demographic variables. In the end, eleven diving schools and some private assessments were used for data collection during fieldwork. The first survey was administered on 5th February for testing with four diving professionals, ten divers and six student divers, who provided feedback regarding whether questions were clear enough and matched the study object; such observations contributed to small adjustments begin made to the question hierarchy. Once the feedback was good enough, after having made minor changes, the surveys were counted as part of the sample size of the population in the study. Fieldwork was conducted from 5th February until 7th April, during which a total of 236 surveys were administered.

Breaking the ice and approaching customers had rough beginnings, as staff were not motivated to help promote the study, which would enable them take advantage of ecological promotion, and show responsible support.

Scuba diving operations start very early in the morning, so sampling sometimes had to be done at 7:30 am to avoid interfering with the operation of the business. On Cozumel, most divers are picked up from their hotels and transferred to one of the marinas, where they will find their diving boat for the day excursion. At the end of the excursion, customers are usually taken back to their hotels, without the need to come back to the school. Also customers come to the reception on the first day to deal with paperwork and to sort out their diving gear, and arrive on the following days just in time to catch the transportation. On Cozumel Island, customers do not hang around the dive shop, unless they have a payment to make or a theoretical diving lesson to attend. The timeframe for assessing divers ended up being very short due to local operational procedures.

Participants were than assessed on random days from 7:30 to 10 am; in some cases, it was possible to approach them during surface intervals at a beach club from 10 to 11:30 am; one school operated try dives for tourists arriving by cruise ship all morning, and also on a random basis, visits were producing effect at the end of the day, around 7 pm. Finding a way to assist the fieldwork, a total of six reused cardboards boxes acted as survey display inboxes, placed inside the diving receptions, and were used to collect twenty eight entry surveys from certified divers. The procedure was very clear and it was also printed on the inbox where divers could pick up an entry survey and return it when completed (see appendix E).

Short talks about the research fieldwork were conducted with student divers signing up for try dives, which took place from 10 am to 2 pm. Participants would arrive on cruise ships, with the majority being from the U.S. and during one period the young generation on Spring Break. To avoid bias, sampling was done on alternative days, and some weeks were skipped so as to not interfere with the demographic profile, but tourists going on try dives represent the major share of the diving experiences on Cozumel Island, after certified divers.

During the two months of fieldwork the data were entered into the SPSS 20 statistical software for controlling and fine tuning variable coding. Also a certificate of recognition was printed for outstanding collaborative support,

signed by both author and the university coordinator from the Sustainable Development Division at the University of Quintana Roo (see appendix K).

3.5. Summary and discussion of Chapter 3

The research document aims at being a future reference for studies about scuba diving, by following scientific approaches implemented during fieldwork, and counting using reliable tools for measuring divers' observations. Scuba diving is the nature-based activity in use for raising awareness, and specifically aims at reducing marine debris by educating tourists visiting a popular diving destination, as a consequence of the negative impacts created by the different types of marine debris, and also due to its transferability to humans' food chain (Ivar do Sul & Costa, 2007; Sheavly & Register, 2007; Moore, 2008; UNEP, 2009; Martins & Sobral, 2011; WSPA, 2012).

Using the water environment as a learning ground for marine debris enhances the opportunity to act by adopting more responsible behaviour in society. Mia and Wei (2013) registered differences in behaviour when people are in their homes, compared to the comfort of a hotel setting; pro-environmental behaviour was noted to be more responsible while at home. The research uses scuba diving and the water environment to activate the senses in tourists experiencing scuba diving. Being exposed to the alien environment and observing marine debris while on holiday can be a predictor for behavioural change in the household.

In 2013, the OECD ranked U.S. as the leading country in municipal solid waste production, with 720 kg per capita of waste produced. The population in the study definitely contributes to the possibility of reducing marine debris, allowing such a study about behaviours for waste management practices to be used for further suggestions and reference. Annual reports issued by the EPA (2013) provide a breakdown of discarded products, registering plastic as the major component of U.S. msw and is one of the least recovered products (8.3%). Also food waste reaches an enormous amount of weight and volume in the landfills, with only 3.9% is recycled.

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Plastic discarded as msw has a big potential for ending up as marine debris, and therefore U.S. divers visiting the majestic Cozumel reef were targeted for participation in a scientific study for understanding behaviours that can lead to reducing food waste and plastic-related products transferred to the local landfills. For studying such behaviour, a measurement tool was developed where divers could register their observations regarding specific variables constituent of the behavioural model.

The importance of profiling divers was necessary for understanding the target population and for crossing information with the different variables used in the study. Divers arrived from coastal areas and from the inland or country side, and registered different measurements by being subjected to personal referents, or social norms which play an important role in driving peoples' expectation to behave in a certain way regarding waste management practices. Also ranking divers by age contributed to comparing data from different sources, and predicting which age groups could be targeted for future environmental education programs. That is to say, using the measurement tool for governance can be an additional purpose of the study,

For registering attitudes toward a responsible behaviour, divers used a 5-point Likert-type scale for rating personal attitudes involving plastic and food items consumption. The scale was ranked from the more favourable attitude like "I do it always" to the less favourable and low scoring "I don't know" or "I never do it". A reliability test was conducted through a comparison with Cronbach's alpha, resulting in a reliable scale to measure the variable of divers' attitude toward behaviour. The Likert-type scale has a multi-item correlation ranging from 0.7 to 0.9, which is a reasonable target to achieve.

The perceived behaviour control that divers have about a certain attitude can be reflected in their answers by perceiving the ability to perform a given behaviour which they can control.

Cozumel is a well-known diving destination, where divers arrive from a multitude of countries, but all have different capabilities, experience levels and diving certifications. For the study, the variable DIVE is a record of divers visiting the reef. For crossing tables and understanding behaviours it is important to know what experience divers have had in the water and their level of certification. Diving is the central variable in the model where everything

connects. Afterwards, the study targeted divers and education in a water environment.

According to PADI (2005), divers and snorkelers are ambassadors of the marine environment as they spend a great deal time enjoying their water activities, and are able to notice changes in the environment. For raising awareness during fieldwork, the PNAC's contribution was used for specific environmental training to all diving professionals, boat staff and people wishing to work in the National Park. Such training is focused on the marine environment and how to handle marine life and minimize impacts. Diving guides perform a general briefing about safety and diving procedures, and also educate tourists on the local marine environment; diving instructors are also required to raise awareness during training and always act as a role model for newly certified divers.

Conducting the study in the field had the cooperation of certified divers signing up for day excursions, participants looking for continued education in diving, first timers, and also non-divers experiencing a one-day scuba diving activity who were required to be with an instructor. The measurement tool is supported by previous research conducted by different scientists (see: Kaiser et al., 2003, pp.15,16; Bortoleto et al., 2012, pp.2198,2199; Rodríguez-Barreiro et al., 2012, p.8; Gunders, 2012; Miao & Wei, 2013, p.106), and it was implemented in three phases. The first survey was administered to all participants, measuring past attitudes and behaviours. To give participants the chance to understand the purpose of the research and of course to allow them the opportunity to have observed marine debris, the second survey was administered to student divers with at least two dives under their belts, or who had participated in a one-day discover scuba diving experience. The last phase was conducted four to six months after the scuba experience on Cozumel, and administered through a web survey, in which participants were evaluated for a post-experience and long-term behaviour change.

The survey administered to student divers was intentionally developed for raising awareness by having respondents answer questions about goods consumed up until the time of the survey such as the plastic bags usually given when shopping for souvenirs or supermarket groceries, and Styrofoam cups widely offered for takeaway drinks, from cafés and small taco stalls as well as food containers and packs of cigarettes. All items were guided by local

perceptions of waste production and management, and also by the “Dive Against Debris – Self Study Guide” from Project AWARE. In this phase, students developed an environmental conscience, and suggested some behavioural changes to follow in their household.

The model designed for assessing divers’ behaviour in the household, regarding plastic and food discards, includes six variables to study. Demographic variables are important to register for understanding the population in the study and profiling divers. Also diving records are important to keep in order to distinguish divers with more experience and potentially more environmental awareness, from students taking a scuba diving training program. The study used certified divers has a model to compare typical behaviour among the diving population, thus newly certified divers or day experience divers were measured in terms of long-term impact regarding eventual behavioural changes caused by scuba diving experience.

Observations were registered using the measurement tool, and put together into a database for further statistical analysis with the SPSS 20 software package. Such exploratory analysis was conducted using a two-step clustering method, organizing divers into groups with similar properties for studying environmental behaviour.

The technique combines both hierarchic and non-hierarchic methods, forming clusters by shifting objects among them and using a cluster feature tree to reach the optimal number of clusters formed. This technique does not require a decision to be made for the initial class of the cluster, by selecting distances between objects to classify (centroid, nearest neighbour, within-groups linkage, Ward’s, etc.), and allows objects to be rearranged among all clusters, which also minimizes outliners.

Statistic software computes the algorithm for a distinguishable statistical analysis, but requires validation of the clusters; such techniques recommend splitting the sample into two equal parts, organizing the samples in a different order, and testing separately using the same cluster technique and settings for analysis. For being declared valid, the solution must not differ significantly, so as to confer reliability to the overall sample.

A discussion was made on whether the cluster analysis and selection produces reliable correlation values. Mooi and Sarstedt (2011) recommended using correlations below 0.90 for cluster selection. Criterion validity is

recommended to be used for detecting distinct groups, by introducing an outside variable, but not used to form the cluster. For example, using the “the part of the country where divers’ live” to distinguish attitudes toward the behaviour, measured on the Likert-type scale.

Also a t-test sample or ANOVA analysis should be used for comparing means and distinguishing valid clusters. It is important to correctly interpret the final result once the cluster process has been done and pictured with a chart solution. Solutions must have an explanation based on comparison of the final results, from the clusters selected for describing or predicting the behaviour in the study.

Cluster analysis can run samples independently ofsample size, although Formann (1984) recommended the measure of 2^m for a minimun sample size, with “m” representing the number of cluster variables.Moreover, there is aneed to validade the interpretation of the cluster solution by using, for example, the t-test sample, ANOVA for comparing their different means, and variance or cross-table for dichotomy variables. By using a random sampling technique, bias was reduced, and over a period of sixty six days U.S. divers were chosen by chance on random days and from the customer lists for day excursions. The first question listed in the first survey screened divers for membership of an environmental organization, which could be a prediction for more responsible behaviour in the household. However, such divers were retained for comparison in the final results, as it is also a target to record whether divers tend to affiliate with environmental organizations, demonstrating some level of engagement in pro-environmental attitudes.

Controlling the minimal sample size resulted in 97 participants for phases one and two, and in the last phase participants were asked to volunteer to receive the personal web survey by email. Such technique combines quantitative methods with qualitative observations for final discussion in this research document. Due to sampling from an unknown population, the expected prevalence of the value to estimate the population proportion was 0.5, representing the most unfavourable option as it provides a bigger sample size. Also sampling occurs with some error margin, and for this research a 10% error was assumed in a 95% confidence interval. That is to say, if the value estimated is only 85% of the real sample size, it means that the real sample size can be found between 75% and 95% of the sample. Using a 10% error is acceptable for

sampling (Valledor, 2000) as it fits well with the distribution of the population sampled. Using lower error values would require a bigger sample, and on Cozumel the majority of students were participating in one-day try-diving experiences, and therefore would under-represent the core courses which take longer to complete.

Surveys were designed to be simple, fast and effective, requiring three to five minutes of the divers' time, and were also meant to fit into the operation of the school and not interfere with local schedules. Cozumel is a popular diving destination (Jiménez et al., 2005) where several diving operators were observed rushing to pick up customers from their hotels and then load them onto the boat before departure.

Long-term impacts were study by several authors, who focused on measuring the outcomes of a nature-based experience (e.g., Ballantyne et al., 2010) such as wildlife tourism experiences in Australia. They used pre- and post-visit questionnaires for measuring long-term impact, and four months after the tourism experience, participants completed a web survey. An extended timeframe for measuring long-term impact was used seven to eleven months following the visit to eight tourism experience centres in the U.S., and visitors were assessed using both telephone and e-mail interviews (Falk, 2007). For testing behavioural changes in the divers' household, long-term impact was measured four to six months after experiencing scuba diving on Cozumel Island.

Contributing to a better understanding of divers' behaviour and the importance given to the PNAC in educating visitors, semi-structured interviews were organized with some diving professionals operating on the island. The picture drawn from these interviews was the importance of good resource management for bringing benefits to all the local population and for the quality of diving on the reef. Natural impacts such as hurricanes cannot be avoided, but human pressure on the coast line, waste management practices, diving practices, and environmental education were highlighted as extremely important to control.

Technical challenges arose right at the beginning of the sampling process. Several diving operators refused to participate in the study, so the list of official PADI diving businesses available on its website was used as a reference, and twelve schools eventually opened their doors to the study and provided some assistance for sampling. Most of the fieldwork was conducted individually,

as local staff were not really motivated to assist in collecting surveys; also time schedules were not very accurate for sampling with diving students.

A special set of side tools such as inboxes being displayed for surveys were made from reused cardboard boxes, and positioned at the diving schools with the most divers. The results were collect and registered on the database.

Chapter 4

4.1. Results

In order to carry out a deep analysis of the observations collected during fieldwork, this section is a registry of all results that can be statistically significant for studying divers' household behaviour in regard to plastic and food discards. During fieldwork 236 divers recorded their data on the measurement tool, developed specifically for this study; moreover, all information presented in this document can be used for updating statistical data for divers worldwide. The population in the study is composed of different nationalities, as it would be rude to deny help in recording data from random divers; however, quantitative statistical results are presented for U.S. divers, as they were the major nationality represented on the island. Observations from random divers were collected in order to create a picture of the different nationalities visiting the reefs of Cozumel, but it was the intention to target U.S. divers for the survey. Different nationalities provided qualitative data for introducing the diving scene, and important details for further discussion in section 4.11.

Results are presented through tables, illustrating the output of the research, and also through graphic representations of the variables and clusters generated from the different phases of fieldwork; such displaying of data is supported by scientific methods and IBM's SPSS 20 statistical software for data analysis. Each variable is described as it appears on the measurement tool, and used for building the three different surveys, thus for clear tracking please use the variable coding in Appendix F.

The compilation of all observations generated the data base in the study, from which the variables introduced on Chapter 3 could be further interpreted. Results reflect the work developed for understanding the model proposed for studying divers' behaviour regarding practices for waste management in the household, with a supplementary literature review supporting important concepts that together with the diving theory introduced in Chapter 1 concluded with fieldwork achievements. Moreover, the observations collected for the study specifically represent the target population, and were representative of the diving scene on Cozumel Island. A series of interviews were conducted to back up the

results and contribute to further discussions about using natural resources for environmental education sessions.

4.2. Analysing the demographic variables – DEMO

Demographic information reveals where the fieldwork was performed (see Table 4.1), giving a brief description of the population in the study. Divers using the services from nine registered diving schools on Cozumel Island were asked to contribute to the research. Also some participants contributed in some informal talks that took place on the street outside the diving schools.

Table 4.1: Diving schools involved in the fieldwork.

Diving school name	Frequency	Percent
Street	5	2.8
Deep Blue	11	6.1
Aldora Divers	38	21.0
Opal Dream	17	9.4
Blue Angel Resort	22	12.2
Tikila	3	1.7
Ramon Zapata	4	2.2
Sand Dollar Sports	76	42.0
Blue Magic Diving	2	1.1
Papa Hogs	3	1.7
Total	181	100.0

Source: Mota, 2013.

The divers registered with the measurement tool revealed a well-developed market for different nations, which is illustrated in Table 4.2. It shows a total of 236 divers representing at least 17 countries diving on Cozumel Island. Different nationalities were registered randomly, but these do not represent the total number of nations visiting the island. Once the target population had been chosen as U.S. divers, efforts were made to approach them, but observations from other nationalities were always recorded if offered.

Table 4.2: Divers' origin country.

Country from where the diver is coming from			
		Frequency	Percent
Valid	**USA**	**181**	**76.69**
	Canada	20	**8.47**
	Mexico	7	**2.97**
	Germany	1	0.42
	France	3	1.27
	Spain	2	0.85
	UK	5	2.12
	Sweden	2	0.85
	Australia	3	1.27
	Russia	1	0.42
	Chile	3	1.27
	Bulgaria	1	0.42
	South Korea	1	0.42
	New Zeeland	1	0.42
	Israel	2	0.85
	Denmark	2	0.85
	Singapore	1	0.42
	Total	**236**	**100.00**

Source: Mota, 2013.

For obvious reasons, U.S. divers lead the table with 76.69% of participants, making a total of 181 surveyed divers, followed by Canadians (8.47%) and Mexicans (2.97%), and 14 more nationalities who participated along with the target population (see Figure 4.1). The numbers are quite small due to it not being a priority for divers to register their observations, and are used only to identify differences in the island's diving market.

The profile update regarding specific variables such as gender and age of divers visiting Cozumel Island provides important details for learning how divers are distributed and there is corroboration with previous studies (e.g., Mundet & Ribera, 2001; Musa, 2003; Todd, 2004; Tourism Queensland, 2006; Belknap, 2008), or whether genders are becoming more balanced like in Musa, Kadir and Lee's (2006) study.

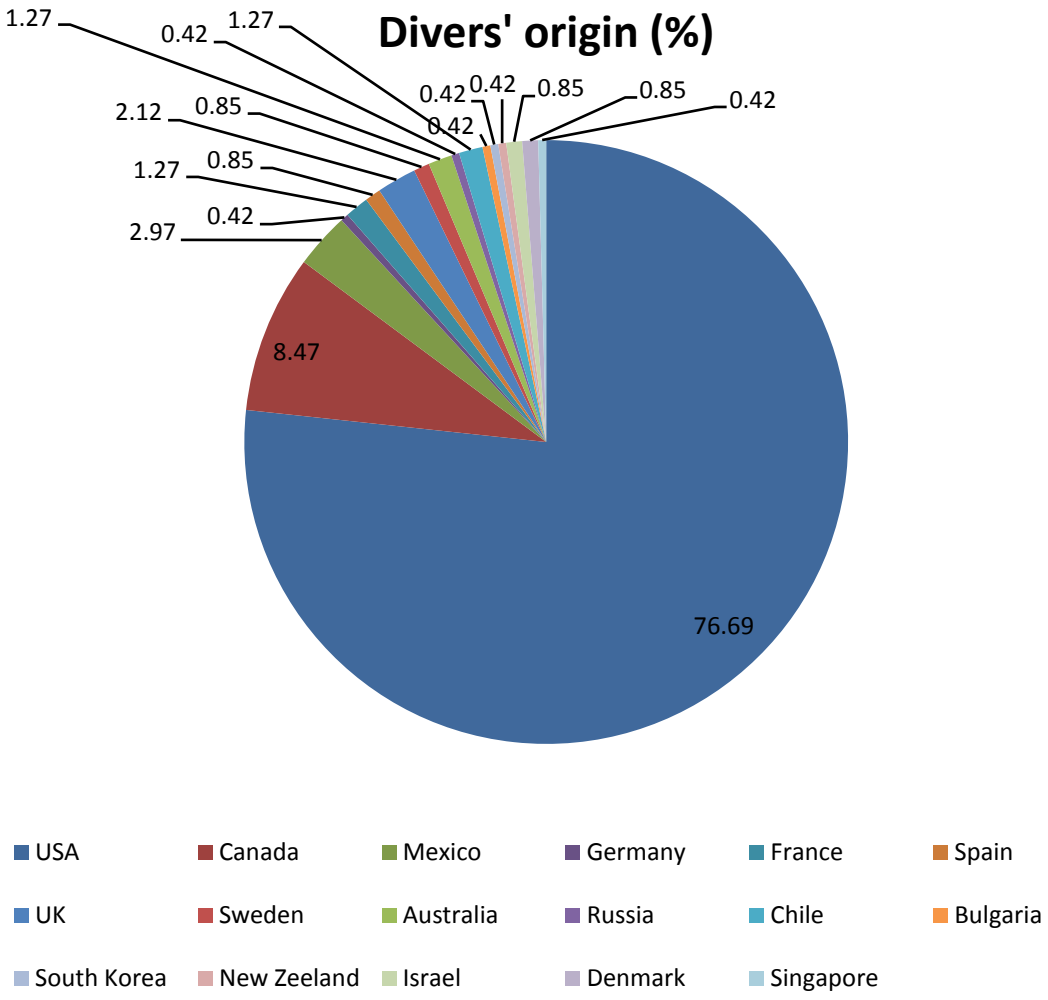


Figure: 4.1: Representation of the countries from where divers' are coming (Mota, 2013).

Different diving operators are focused on specific markets like, for example, European tourists or South Americans traveling to the Mexican Riviera, who are all, willing to pay a visit to Cozumel Island. Every diving school is quite receptive to hosting divers arriving from anywhere. Figure 4.1 illustrates a small sample of international divers recorded during the fieldwork.

From a total of 236 participants, the age range represents 53 years' difference between the youngest participant, who was 18, and the oldest, 71. Despite the mean age being 36.79 years old, the modal age was registered as 18, characterizing a very young population visiting Cozumel Island for scuba diving activities (see Table 4.3).

Table 4.3: Profile for all divers participating in the study.

Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean	Median	Mode	Std. Deviation
6.4 - Please write your age:	**236**	**53**	**18**	**71**	36.79	34.50	**18.00**	14.324
3.2 - In total, how many dives do you have?	135	4196	**4**	**4200**	222.26	**43.00**	**10.00**	**588.613**
2.1_1 - Yes. How many times?	54	**149**	1	150	16.02	4.50	**1**	26.712

Source: Mota, 2013.

Also, divers participating in the study were divided into two subpopulations – one for characterizing certified divers and the other for characterizing diving students. Among all certified divers, the maximum number of dives registered was 4200 and the minimum 4, which illustrates very well how much experience some divers have, and is shown by the large standard deviation (588.613). However, the numbers were reduced drastically, showing a median value of 43 dives, and a modal number of 10 dives. Characteristics of the whole population vary greatly from the population target, in particular on the modal number of logged dives (see section 4.3.1).

Divers taking diving courses and non-divers participating in discover scuba diving programs (not a certification) also registered some previous experience in the open-water environment, having a range of 149 dives, but the modal number of 1 dive is typical for repeaters on a discover scuba diving experience or those taking entry-level diving courses for certification.

Table 4.4 lists the profiles of the divers from the study's target population, consisting of 181 U.S. divers, comprising certified divers enjoying the reefs of Cozumel and student divers taking entry-level courses, continuing education, or day diving experiences.

Table 4.4: Correspondent divers' socio-demographic profile on Cozumel Island.

Socio-Demographic characteristics	Frequency	%
N total	**236**	100.00
N valid (Americans U.S.)	**181**	**76.69**
Gender		
Male	111	**61.33**
Female	70	**38.67**
Age		
18 - 30 years old	77	**42.54**
31 - 40 years old	29	**16.02**
41 - 50 years old	31	**17.13**
> 50 years old	44	**24.31**
Country area		
Inland	141	**77.90**
Costal	40	**22.10**
Living area		
Rural	49	**27.07**
Urban	58	**32.04**
City	64	**35.36**
High populated city	10	**5.52**
Education		
High school	41	**22.65**
Bachelors	79	**43.65**
Master	40	**22.10**
Ph.D.	7	**3.87**
Other	14	**7.73**
Annual Household income		
<= 15,000 USD	15	**8.29**
15,001 to 25,000 USD	11	**6.08**
25,001 to 35,000 USD	10	**5.52**
35,001 to 45,000 USD	22	**12.15**
more than 45,000 USD	123	**67.96**
Motivation		
Leisure	74	**40.88**
Diving	45	**24.86**
Nature	1	**0.55**
Beach holiday	11	**6.08**
Business	2	**1.10**
Other	7	**3.87**
Diving and other	41	**22.65**

Source: Mota, 2013.

The population in the study was registered as comprising 61.33% male and 38.67% female divers. Participants were selected randomly on random days of the diving season, and they represent the actual diving population on Cozumel Island.

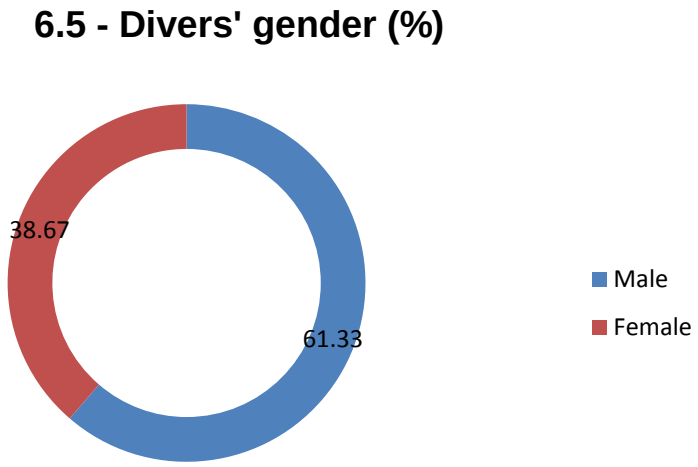


Figure 4.2: Correspondent divers' gender on Cozumel Island (Mota, 2013).

Divers were ranked in order to fit a typical age description and for better comparison with previous studies (Ong & Musa, 2011). The biggest percentage of divers, illustrated in Figure 4.3, represents the age range from 18 to 30 years (42.54%), including some of the young generation traveling by cruise ship during Spring Break. To avoid overrepresentation, some samples were taken on random weeks, but a tendency was noticed for tourists to go on day trips with certain diving schools located closer to the harbour where their ship was docked. The age range from 31 to 40 years (16.02%) represents a quite regular sample among the different diving schools participating in the study, and also divers aged from 41 to 50 years (17.13%) were well represented in the Cozumel diving scene. The second most regular group and quite representative of Cozumel divers comprise divers aged over 50 years (24.31%).

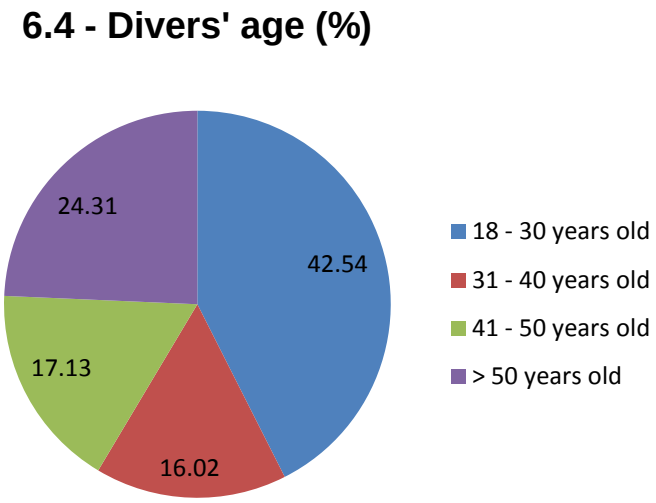


Figure 4.3: Correspondent divers' age diving on Cozumel Island (Mota, 2013).

The island is a very welcoming place hosting many "repeaters", as stated by some diving operators interviewed for the study. Some operations rely on repeat customers and tend to have a consistent turnover throughout the year. Divers arrive from all over the world, and the population in the study registered whether divers were more settled on coastal areas, or if distance to the water environment has no affect at all. Figure 4.4 shows the respective distribution of U.S. divers within its borders, registering more divers living inland (77.90%) than settled on coastal areas (22.10%).

It turned out not to be the case that people living on coastal areas are keener to participate in scuba diving activity; furthermore, inland scuba diving can take place in lakes, quarries or even rivers, stimulating divers to be active, and promoting the activity among new participants. In order to provide detailed explanations, further research can be conducted to gather representative data regarding U.S. divers' scuba activity and country geo-location.

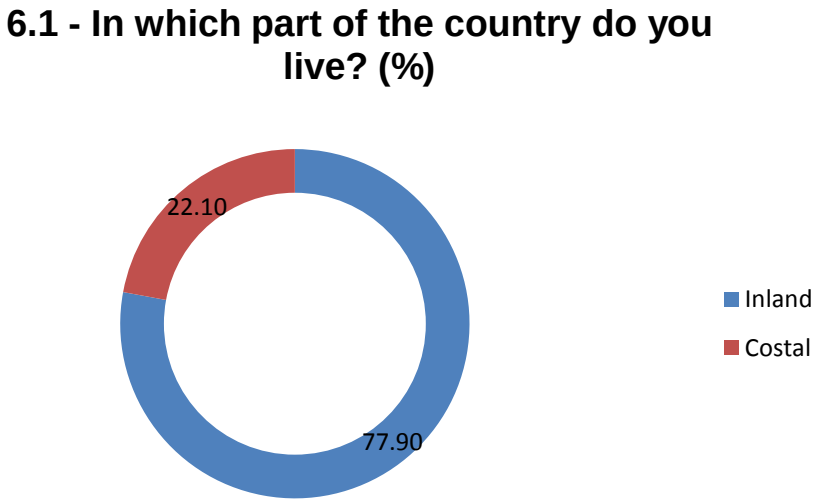


Figure 4.4: Correspondent country area where divers have their permanent residence (Mota, 2013).

Also Figure 4.5 illustrates how divers are spread among their neighbourhoods; divers were asked to classify their living area with the majority living in cities (35.36%) being very much like divers living in urban areas (32.04%). Urban areas can be classified into several forms; therefore, participants were briefed about the definition used for this research, which followed that given by the Rural Development Act of 1972 mentioned in Chapter 3, section 3.2.3.1. Also urban areas can be located in the surrounding areas of a city, be developed or undeveloped, but always situated in a non-agricultural area. According to Weeks (2010, p.33), people living in urban areas can also be described as “having the qualities or characteristics associated with town or city life; esp. elegant and refined in manners, courteous, suave, and sophisticated”. Rural areas (27.7%) are also representative of the preferred place for living among divers, giving consistency to the sample and a good distribution also.

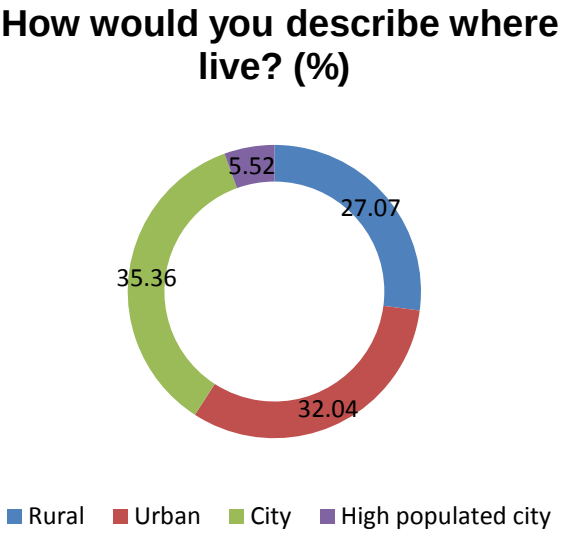


Figure 4.5: Correspondent living areas where divers have their permanent residence (Mota, 2013).

In the sample analysed, divers registered a low percentage for choosing their living quarters in highly populated cities (5.52%). Reasons were not asked as the scope of the study was simply to identify divers' geo-location in the country, although entry-level students can be found less in highly populated cities than certified divers (9.09 – 1.16%). Of the divers living in rural areas (30.30 – 25.58%), students are represented almost 16% less than certified divers, but it levels up for urban areas where both groups (32.32– 33.72%) display quite similar characteristics for divers' favourite place to live (see Figure 4.6). Moreover, living in a city might attract entry-level students more than certified divers (41.86 – 28.28%). It must be noted that the sample for entry levels represent divers without previous membership of a diving organization, and non-divers on a day diving experience.

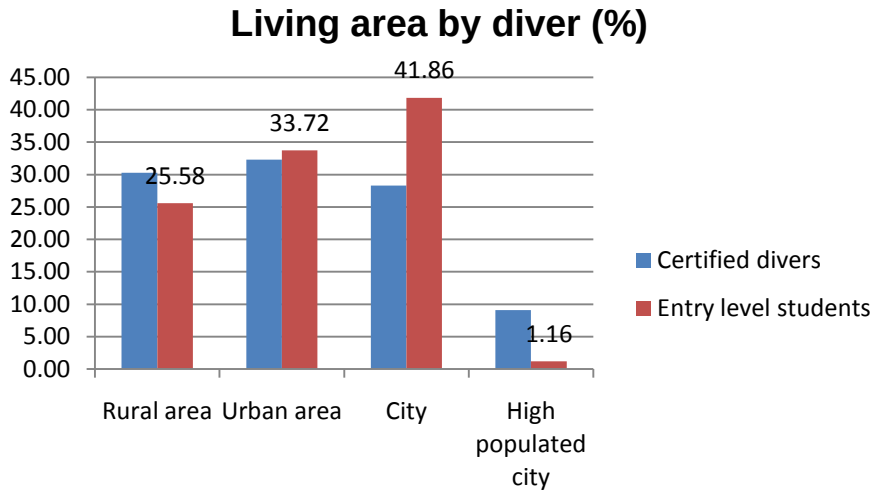


Figure 4.6: Comparison between certified divers and entry-level divers by classification of living area (Mota, 2013).

Regarding divers' education levels registered during fieldwork, Figure 4.7 shows that bachelors represent the higher percentage of divers (43.65%), followed by high school (22.65%), which is very much like the percentage of divers holding a master degree (22.10%). Other types of study (7.73%) like advanced nursing, associate degree, doctor of dental surgery (DDS), professional juris doctor (JD), medical doctor (MD), technical school, trade, and some college courses were also registered for describing the different ranks used on the measurement tool (High School; Bachelors; Master; PhD). The lowest rank, and the one requiring more ability, time, economic availability and interest is Ph.D., represented by 3.87% of the divers sampled during fieldwork.

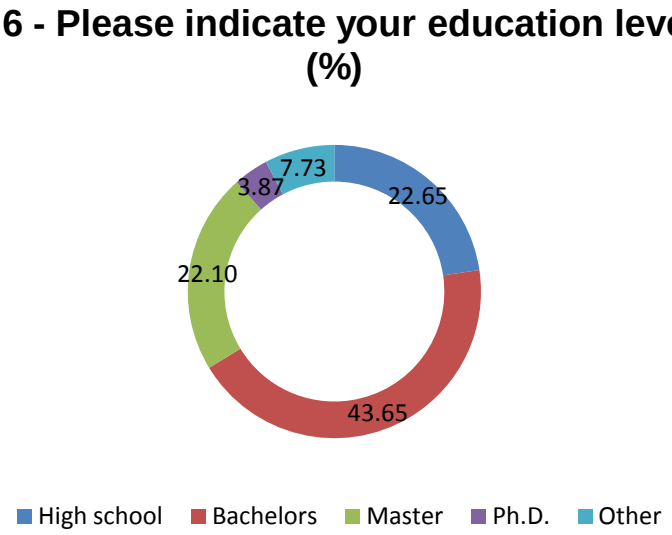


Figure 4.7: Correspondent divers' education level (Mota, 2013).

As already stated in studies conducted by Ditton and Baker (1999), WTO (2001), and Grőssling et al. (2004), there is a tendency for relating divers' income (see Figure 4.8) to scuba diving activity, as it requires a certain level of economic affluence for traveling to new diving grounds, equipment purchase, accommodation and further diving education. In the sample collected during the fieldwork, there was a predominance of divers having an annual household income greater than 45,000USD (67.96%), followed by the rank created for 35,001 to 45,000USD (12.15%), and the opposite extreme where divers collect less than 15,000USD in their annual household income (8.29%). The last two categories fit with divers earning 15,001 USD to 25,000USD (6.08%), and 25,001 to 35,000USD (5.52%) marking the distribution for divers' profiles regarding annual household income.

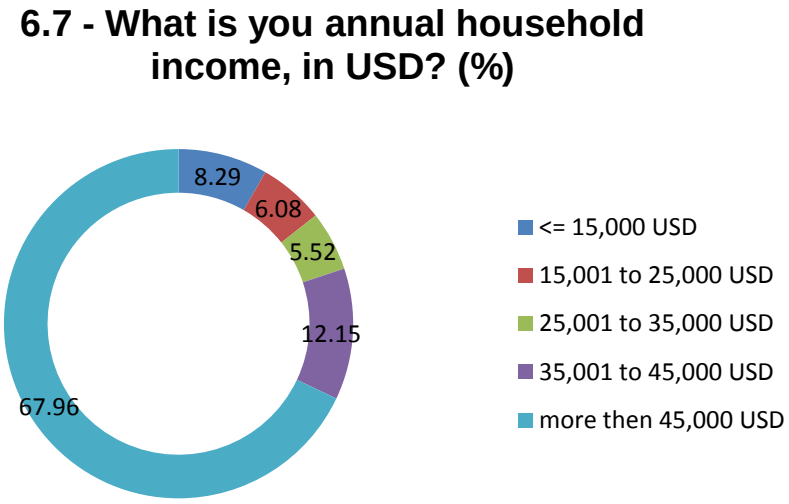


Figure 4.8: Correspondent divers' annual household income, in USD (Mota, 2013).

Divers visiting Cozumel Island registered a wide range of motivations, which are illustrated in Figure 4.9. It is clear that divers are seeking enjoyment on the reefs of Cozumel, being sampled for their primary motivation for visiting the island, and where scuba diving and other activities are relevant during their stay. Leisure is the overall motivation for visiting Cozumel Island (40.88%), followed by diving as the primary motivation (24.31%); participants were also surveyed for secondary motivations where diving and other motivations (22.65%) represent interest in scuba activities, so for statistical representation diving is the leading motivation for their presence on the island (24.31 + 22.65 = 46.96%). A motivation for divers is beach holiday (6.08%), representing a small fraction of the primary motivation, but this was much higher than any other motivations (3.87%) such as being a cruise ship member, drinking, honeymoon, traveling on a cruise ship, being on a senior trip, regular holiday, trying something new or just trying tequila and Cuban cigars. Motivations for business (1.10%) were also registered among divers, and nature (0.55%) as a primary motivation was the lowest-ranked interest for visiting the island. The last motivation listed in this document can easily be linked with scuba diving, but it must be respected that observing nature on Cozumel Island does not necessarily mean scuba diving. As well as the coral reef the island features

mangroves and wetlands, which are also attractions for nature-based activities such as watching wild animals and non-formal education programs, etc.

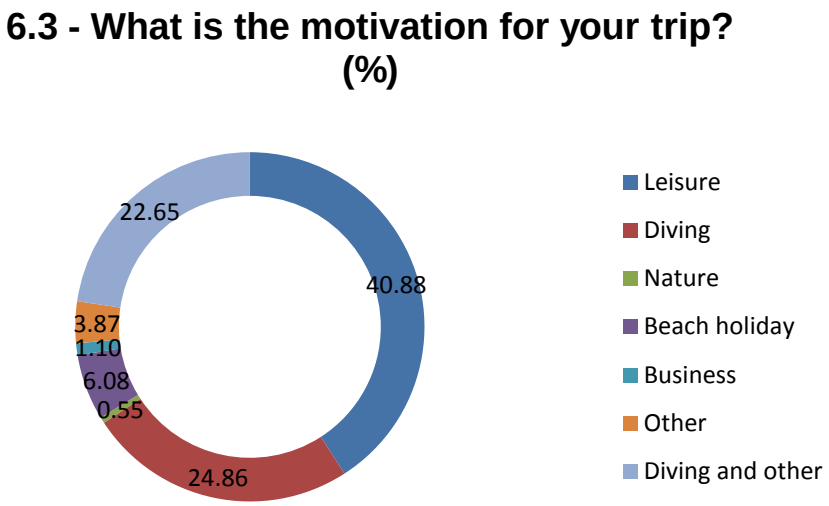


Figure 4.9: Primary motivation for visiting Cozumel Island (Mota, 2013).

Divers' demographic profile has been presented, and will be used also for modelling the variables forming clusters where demographic variables can be determinative for dissimilarities between clusters formed. Furthermore, socio-demographic variables will be tested as predictor for environmental behaviours in the household, regarding plastic and food discards.

4.3. Analysing the scuba diving variables – DIVE

Studying divers' pro-environmental behaviour is one of the reasons why participants were surveyed on Cozumel, being a registry of a nature-based activity for observing marine life while underwater. The study population included divers holding any recreational diving certification from any dive training agency, and non-divers participating in PADI course certifications, including PADI introductory courses (not a certification) during the fieldwork phase (see Table 4.5).

Table 4.5: Correspondent divers' diving profile on Cozumel Island.

Divers' characteristics		Frequency	%
N total		**236**	**100.00**
N valid (American U.S.)		**181**	**76.69**
Certified divers		**99**	**54.70**
Missing system		82	45.30
Level	SD	1	**1.01**
	OWD	63	**63.64**
	AOWD	16	**16.16**
	Rescue	12	**12.12**
	DM	5	**5.05**
	Instructor	1	**1.01**
	MSDT	1	**1.01**
Diving students		**100**	**55.25**
Missing system		81	44.75
Dive before	Yes	41	**41.00**
	No	59	**59.00**
Level	DSD	74	**74.00**
	SD	2	**2.00**
	OWD	10	**10.00**
	AOWD	11	**11.00**
	SP	2	**2.00**
	Divemaster	1	**1.00**

Source: Mota, 2013.

From a total of 236 surveyed divers, 76.69% had arrived from the U.S., and were either U.S. citizens or another nationality but resident in the U.S. Participants were divided into two different groups (see Figure 4.10): certified divers signing up for day diving excursions (54.70%), and diving students (55.25%) consisting of certified divers taking any continuing diving education course, non-divers taking their entry-level course (Scuba diver – SD; open-water diver course – OWD), or participating in an introductory day-diving experience (discover scuba diving – DSD).

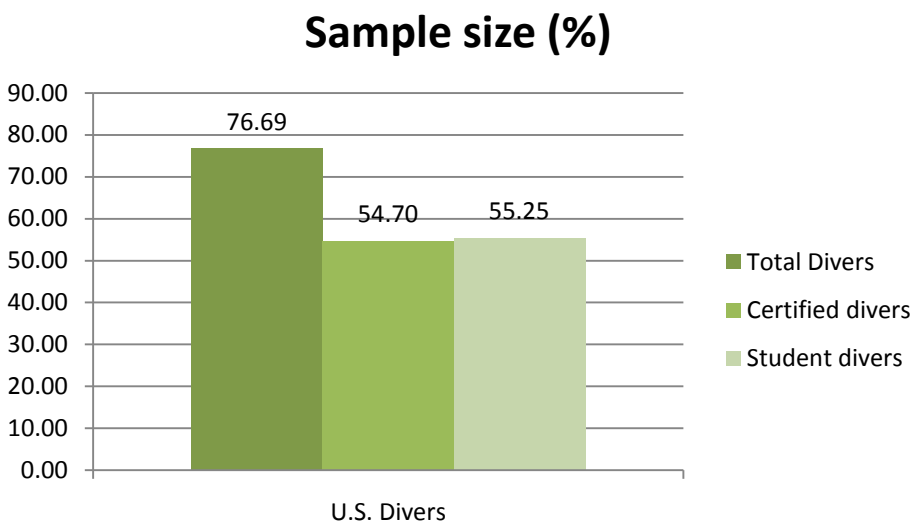


Figure 4.10: Divers' subpopulations sampled for the study (Mota, 2013).

Certified divers taking continue education courses, were also included in the sample for diving students, allowing the model to be run and long-term impacts from scuba diving activity to be studied. Figure 4.10 illustrates the number of divers participating in the study at different sample sizes. This allowed the opportunity to compare typical divers' behaviour with that of newly certified divers after having undergone an additional environmental awareness session.

4.3.1. Certified divers

Certified divers are described as any participant holding a recreational diving certification from any diving training agency (see Table 4.4). Certified divers do not need to go diving with an instructor, but must always have a diving buddy; however, diving becomes more fun and interesting if divers receive local area orientation from diving professionals, be they dive masters or diving instructors who are always pleased to escort divers to the dive site, check on their safety, supervise good diving practices, and of course point out the most interesting species on the reef.

In the sample size of 99 certified divers, seven different diving levels were registered (see Figure 4.11).The lower entry-level certification scuba diver

(SD – 1.01%) allows divers to descend to a maximum depth of 12 m, while accompanied by a diving professional. Open-water certified divers (OWD – 63.64%) hold the most-wanted certification, as it allows them to go together with a buddy to a maximum of 18 m deep. More advanced divers possess of the advanced open-water diver certification (AOWD – 16.16%) allowing them to descend to a recommended maximum of 30 m. Divers with experience with primary and secondary care training, together with some different rescue scenarios, usually hold the rescue-diver certification (Rescue – 12.12%), and tend to be more responsible divers while underwater and are able to respond to a distress situation. PADI professional levels were also represented in this study, with divemaster (5.05%), diving instructor (1.01%) and one master scuba diver trainer (1.01%).

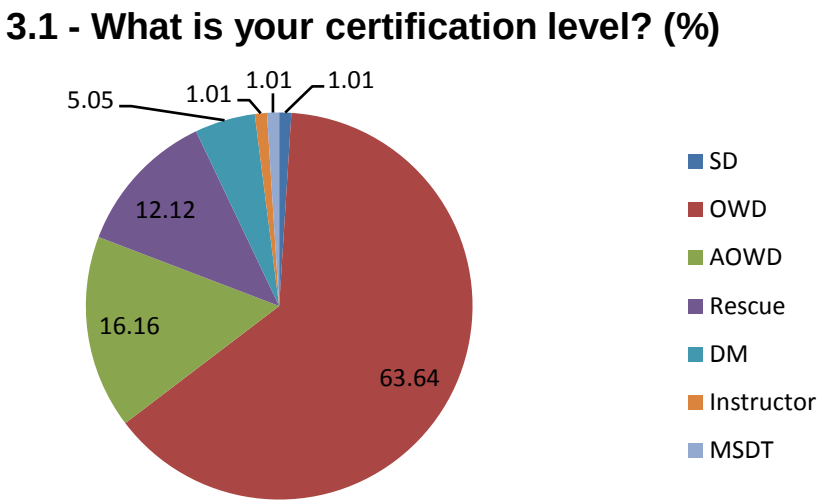


Figure 4.11: Divers' certification level on Cozumel Island (Mota, 2013).

U.S. divers registered during fieldwork were aged from 18 to 71 years, and had a median value of 42 years, although the modal age was registered at 56 years. Cozumel caters for all tourists visiting the island. The certified divers subpopulation tended to be quite experienced and made up of mid-age divers (see Table 4.6).

Table 4.6: Profile of certified divers.

Descriptive Statistics								
	N	Range	Min	Max	Mean	Median	Mode	Std. Deviation
6.4 - Please write your age:	99	53	**18**	**71**	43.29	**42.00**	**56.00**	13.389
3.2 - In total, how many dives do you have?	99	**2996**	**4**	**3000**	**162.00**	**40.00**	**100.00**	**378.525**

Source: Mota, 2013.

Regarding number of dives, newly certified divers with 4 dives to a maximum of 3000 logged dives were registered. Participants with a higher number of logged dives are considered the most experienced divers, but do not necessarily hold all of the diving certifications. Divers had a mean number of 162 dives, on a dive range of 2,996, and of course with a big standard deviation (368.525). For a better description of the certified divers group, the median number of dives was 40, and among all experienced divers the mode was represented by 100 dives, which was very different to the number described for the modal number of the entire sample (mode = 10).

For measuring behavioural changes derived from diving activity, some of the certified divers participated in the last phase of the study that looked for a pattern of typical behaviour regarding household waste management, which is one of the purposes of this research work. However, not all participants registered for the last phase, and some who had expressed willingness did not fill out the web survey in the end.

4.3.2. Student divers

The great reef located on the PNAC is the stage for a multitude of dive training courses, in particular for tourists experiencing one day diving experiences, called PADI discover scuba diving. For such programs, it is required to attend to a theory lesson given by a diving instructor and to master some skills in confined water, which is also required before entering the deep open-water environment, and to a maximum of 12 m deep. Statistics from

fieldwork revealed participants taking diving certification courses and discover scuba diving, already had some experience in the open water (41.00%), as illustrated in Figure 4.12.

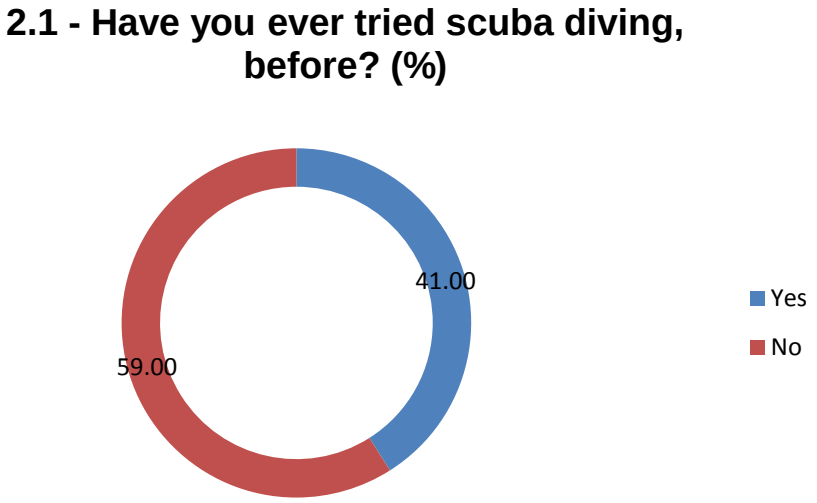


Figure 4.12: Previous diving experience of student divers (Mota, 2013).

Student divers with previous scuba diving experience are characterized as certified divers taking continuing education courses, who registered a maximum of 150 logged dives. However, non-divers are well represented in the sample, with some having already experienced the open-water experience at least once. Another indication of the distribution of the sample, among beginners and continuing education students, is the low modal value indicated (1).

Divers' age ranged from 18 to 63 years, presenting a modal age of 22, and median age of 26, and characterizing the student divers' profile. Cozumel student divers' profile is much younger than the one presented for certified divers, which can be attributed to the high popularity of the island as a cruise-ship destination, in particular during the U.S. Spring Break holiday (see Table 4.7).

Table 4.7: Profile of diving students.

Descriptive Statistics								
	N	Range	Mini	Max	Mean	Median	Mode	Std. Deviation
6.4 - Please write your age:	100	45	**18**	**63**	31.63	**26**	**22**	12.292
2.1_1 - Yes. How many times?	41	149	**1**	**150**	15.76	3	**1**	28.512

Source: Mota, 2013.

Participants, who had gone on a day diving experience, and those on entry-levels certification courses, are illustrated in Table 4.8, where day diving experience was recorded as highly demanded with 86.05%, followed by the most wanted diving certification OWD with 11.63%, and the 2-day course SD with 2.33%.

Table 4.8: Entry-level courses, and discover scuba diving during fieldwork.

2.2 - Which diving course are you taking?			
		Frequency	Percent
Valid	DSD	74	**86.05**
	SD	2	**2.33**
	OWD	10	**11.63**
	Total	86	100.0

Source: Mota, 2013.

The Port Authority from of the state of Quintana Roo (APIQROO, 2012), registered 2,744,952 passengers visiting the island by cruise ship in 2012, spending an average of 7 – 11 hours ashore. Most of the DSDs arrived by cruise ship, as Cozumel is a very well-known destination for scuba diving and beach holidays. That is one of the reasons why the OWD certification course has such a high percentage compared to the leading activity on the island, which also requires around four days of training, and is accessible only to tourists staying overnight.

To understand about divers' continuing education, Table 4.9 gives information about U.S. certified divers engaging indifferent courses.

Table 4.9: Number of certified divers taking continuing education courses.

3.1 - What is your certification level? * 2.2 - Which diving course are you taking? Cross-tabulation

		2.2 - Which diving course are you taking?					**Total**
		DSD	OWD	AOWD	SP	Divemaster	
3.1 - What is your certification level?	SD	0	1	0	0	0	1
	OWD	3	0	11	1	0	15
	Rescue	0	0	0	1	1	2
Total		**3**	1	11	2	1	**18**

Source: Mota, 2013.

Continuing education courses are any course after certification for entry level, and 15 divers upgraded their level (1+11+2+1=15), with3 other certified divers deciding to take the DSD experience as a refresher course to enjoy scuba diving with their families, and the total certified participants registered for continuing education courses was 18 in total.

Diving levels follow a logical sequence and were designed for all types of diver; all are performed based and include theory and practical segments. Today, for people hooked on new technology and having internet access, PADI is offering online theory lessons to maximize tourism experiences, allowing tourists to arrive at the diving destination ready to start their water-skills training components. During fieldwork five certifying courses and one day experience course (not a certification) were registered.

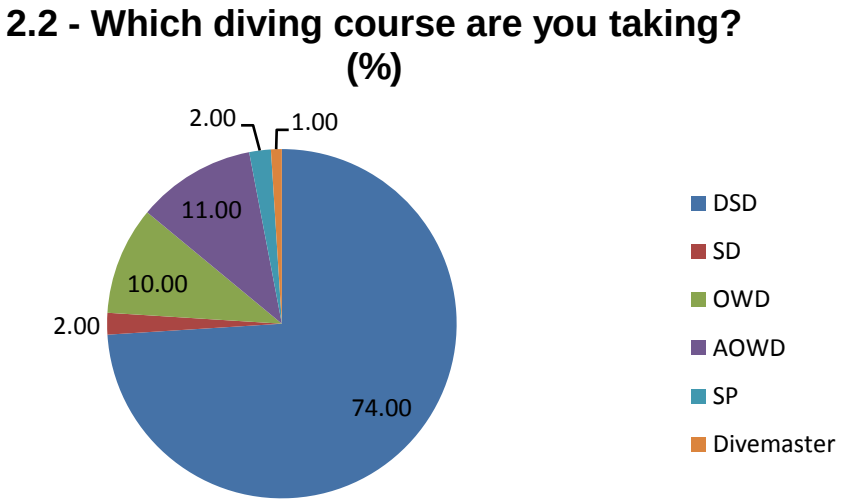


Figure 4.13: All diving courses taken during fieldwork (Mota, 2013).

Diving students were required to participate in the second phase of the study (survey 2), as it is the link between diving experience, marine debris and behavioural change in the household. Figure 4.14 compares the time spent on the island for scuba diving, which reveals big differences.

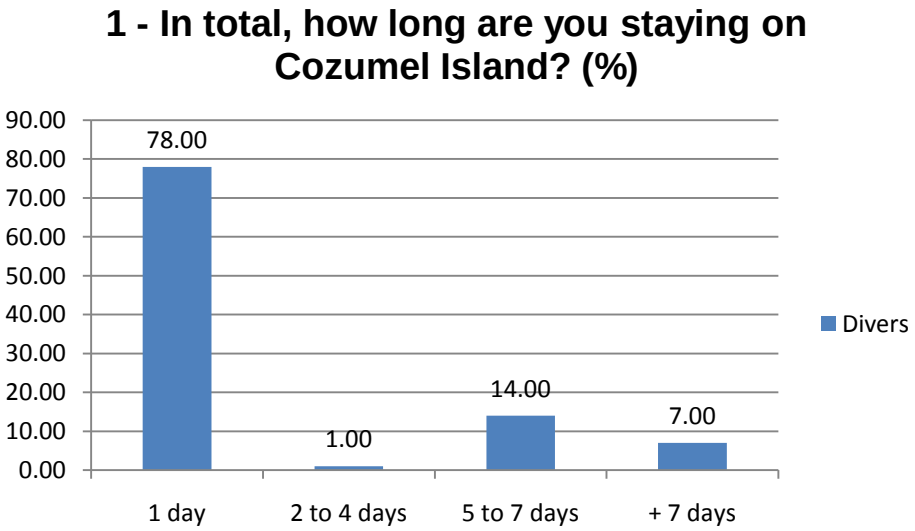


Figure 4.14: Time spent on Cozumel Island for participating in diving courses (Mota, 2013).

Cozumel is an island that lives off day excursions (78%), in particular from cruise-ship passengers and crew members. Almost every day, thousands of tourists arrive on Cozumel to enjoy its attractions. Participants who had chosen to stay overnight registered a quite normal distribution along the typical time for staying on the island. Just a few participants registered that they were staying two to four days (1%), reaching anew peak (14%) of five to seven days, and descending infrequency for more than seven days (7%). These are the participants taking continuing education courses due to having more time to complete the whole of the diving course.

4.4. Analysing the variable for awareness – AWARE

The variable aware indicates potential environmental awareness that divers might have. It is a supposition of knowledge, and conscience that might interfere with attitudes towards certain behaviour, such as having acquired a conscience regarding the potential impacts created by personal actions on land. Also screening divers for membership of any environmental organization can reduce bias in our results.

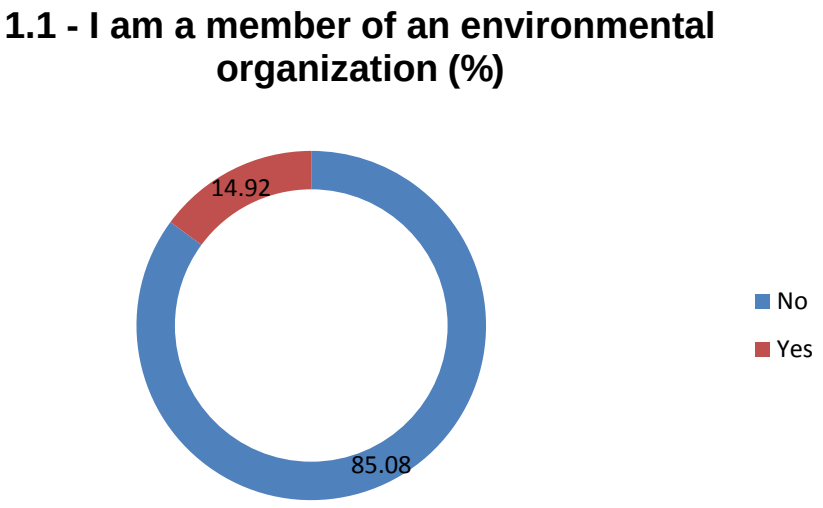


Figure 4.15: Percentage of divers with a membership of an environmental organization (Mota, 2013).

In this section, the results will be tested to verify if 14.92% having membership of an environmental organization (see Figure 4.15) is enough to bias the results, and how much influence it has for creating new clusters. The majority of the population does not hold a membership of an environmental organization (85.08%), but U.S. participants reporting some membership were for:

- ADK Mountain Club,
- American Alpine Club,
- Arbor Day Foundation,
- Coral Reef Alliance,
- DAN - Divers Alert Network,
- Environmental law Clinic @ Harvard law,
- Moose Mountain,
- National Ocean Conservancy,
- National Ocean Institute,
- National Rifle Association – NRA,
- Nature Conservancy,
- NAUI Northwest Environment,
- Project AWARE,
- Pollution Prevention Roundtable,
- Port of Houston,
- Reef,
- Sea Shepherd,
- SRI,
- Wildlife International,
- Wyoming Outdoor Council

(Mota, 2013).

While among international divers who mentioned their membership, general preferences were for:

- Be Aware,
- Canadian Wildlife Federation,
- Ecotonica,
- Sierra,
- Tpurrue,
- WWF

(Mota, 2013).

Indeed non-governmental organizations can motivate divers to take a membership subscription or become active members by participating, for example, in educational forums, civil action for beach cleaning like those organized with guidance from Project AWARE, preventing pollution, etc. All can

be a reason for sharing experience or learning with other people willing to share information about certain matters. Figure 4.16 reveals that 72.93% of the 181 divers had an interest in talking with friends about problems related to the environment. Already some level of environmental awareness is demonstrated, which plays an important role in the presented model for testing behavioural change in the household as a result of scuba diving activity.

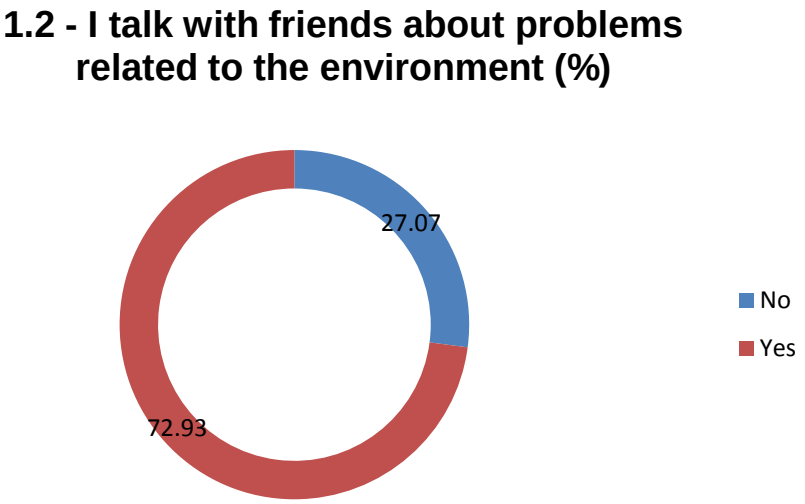


Figure 4.16: Percentage of divers who talk about environment with friends, listed in survey 1 (Mota, 2013).

U.S. divers registered an interest in talking about:

- Air quality,
- Animal safety,
- Animal cruelty,
- Animal rights,
- Anything,
- Climate change,
- Conservation,
- Conserving energy and water,
- Conservation,
- Deforestation, Diver education,
- Environmental protection,
- Eco-friendly sustainability,
- Ecology conservation, Energy,
- Environmental racism (dumping toxic waste in developing countries and 1st peoples' land),
- Fresh water factory farming,
- Food quality,

- Garbage,
- Garbage and population,
- Global climate change,
- Global warming,
- Harbour sludge recycled for compost,
- How cruise ships affect the environment,
- killing sharks,
- Land use,
- Natural resources,
- Ocean pollution,
- Oil drilling and spills,
- Overpopulation,
- Ozone,
- Pollution impact on animal habitats,
- Plastic,
- Plastic use,
- Plastic waste,
- Pollution,
- Resources,
- Recycling,
- Reef, Reef damage,
- Reef quality,
- Renewable energy,
- Reusing, recycling,
- Safety Sewage,
- Sharks,
- Smog,
- Stewardship,
- Trash compaction,
- Weather,
- Whales and pollution,
- Waste management,
- Waste recycling,
- Water,
- Water quality,
- Water pollution,
- Waste

(Mota, 2013)

And obviously nature lovers, in particular scuba divers from other nations, share more or less the same subjects related to the environment:

- Air quality in China,
- Coral bleaching,
- Coral disease,
- Deforestation,
- Dolphinariums,
- Energy and water,
- Farming,
- Fishing problems and reef exploration,
- Garbage and recycling,
- Garbage on the water,
- Global warming,
- Impact of big corporations,
- Litter,
- Marine conservation,
- Marine debris, Coral bombing,
- Oceans, Oil,

- Oil reserves in Canada
- Organic food,
- Over population,
- Overfishing and pollution,
- Recycling,
- Reef ecology,
- Resources overexploited,
- The problems at the sea,
- Temperature,
- Tourism effects on nature,
- Waste

(Mota, 2013).

Membership of environmental organizations and an interest in talking about how nature is treated is an actual practice among divers, but the study is attempting to understand how much scuba diving can affect divers' behaviour, to make them more conscientious and reduce their ecological footprint.

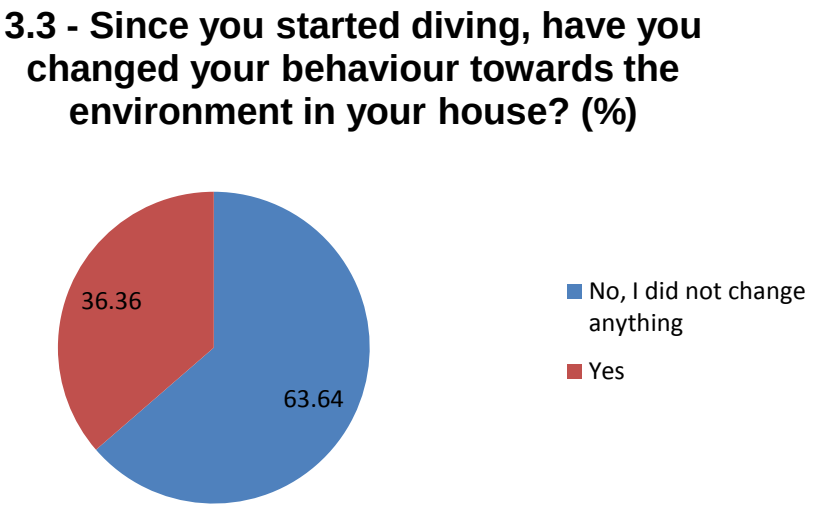


Figure 4.17: Environmental behaviour change result from scuba diving activity, listed in survey 1 (Mota, 2013).

Certified divers are also measured in order to form a description of their typical behaviour, and also for understanding if they have been motivated to change their environmental practices in their household. In Figure 4.17, a good portion of the sample shows that behaviour in the household changed as a consequence of scuba diving. In contrast, 63.64% of divers did not associate

their actual behaviour with the scuba diving they had done, and what they saw underwater had no effect regarding the practice of waste management in the household for plastic and food discards.

U.S. divers registering changes in their behaviour stated:

- “Attitudes, awareness“.
- Awareness of water pollution, effects of tourism and development on reefs“.
- “Became more aware of the need to conserve and protect“.
- “Become aware of endangered species and more clean water“.
- “I already recycled but was more aware of the impact“.
- “I am more concerned about things“.
- “Less plastic waste, composting“.
- “Less trash, more recycle“.
- “Limit the seafood I eat“.
- “More aware of coral“.
- “More aware of the ocean, want to protect it“.
- “More conscience of bad influences“.
- “More conscious of the reef environment“.
- “More recycling, conserve electricity, bike ride to grocery store“.
- “My habits“.
- “No more littering“.
- “Only buy sustainable fish“.
- “Potting less“.
- “Recycle“.
- “Recycle, reuse, compost, etc. “.
- “Recycle. Be more energy conscience“.
- “Recycling, breaking plastic rings, use less plastic“.
- “Reduced plastic“.
- “Reusable bags at store, but not directly related to diving“.
- “Save light bulb“.
- “Sensitivity about trash/garbage in ocean“.
- “Stopped eating fish that I count“.
- “Try to be more aware of protecting the environment“.

- “Use less plastic products“.
- “Use less, more conscious of electric, water, paper and plastic use“.
- “Water conservation, recycling“.

Based on such statements it can be verified that scuba diving was very important for environmental awareness and even for inducing people to change their routine in order to minimize their ecological footprint. The study is focused on plastic waste and food discards, but a wide variety of behaviours were revealed that people can adopt. Changes can arise through gathering more information about sensitive subjects, which motivates people to act.

The registry of non-U.S. divers also produced good feedback for understanding if scuba diving can affect attitudes toward better environmental practices. Divers changed their whole environmental perception by increasing their “environmental awareness” and caring for the “environment for the house”. Practices changed for “reducing garbage … not buying products or articles made by sea life … plastic optimization”, and “saving water and energy”. Apparently “reduce water waste”, and recycling became of interest for divers as they “recycle everything possible, … recycle plastic and paper at house and office, … recycle more; avoid littering (cigarettes on the floor)”, and “use recycle bottle and no more plastic bags“ (Mota, 2013).

Divers showed an interest in preserving the environment by participating actively whenever they could, for example, some divers changed their food habits so that they were ”not buying more fish species in markets, … try not to eat octopus, … less fish eating, … or … reduce fish consumption”. Divers became more aware “regarding ocean environment” and “regarding our natural resources, parks, etc. …more aware of plastic bags and fishing nets” (Mota, 2013).

With professional experience, it is important to measure the level of satisfaction that a diving student had during their training course. Divers who did not have such an enjoyable experience showed a tendency to disconnect from the activity; however, this is not the rule for every situation as people can always repeat the course and leave satisfied at a later time. In our research, only 1 U.S. diver did not enjoy the experience (3 in total), and also did not register any

comments to report why; neither did they registered an opinion on the long-term impact web survey.

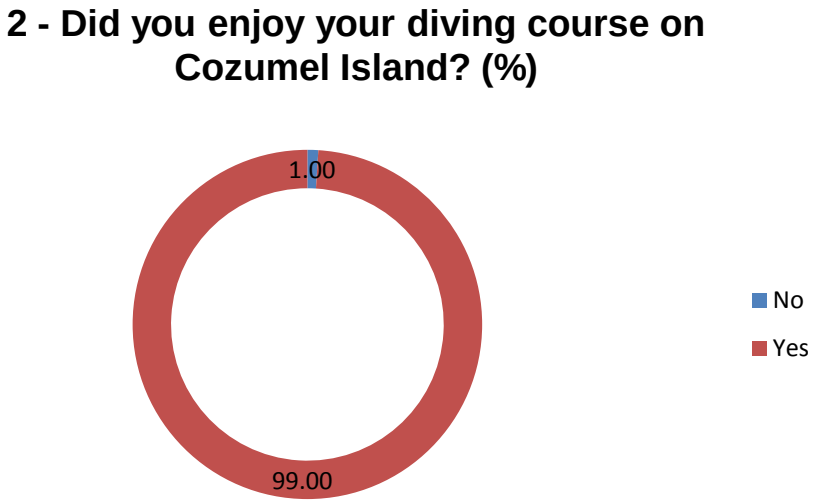


Figure 4.18: Enjoyment level of participants, registered in survey 2 (Mota, 2013).

Environmental awareness can also be considered every time participants leave their comfort zone while on the island. Living a different reality away from home with different environmental conditions, language, hospitality and environmental practices for waste management. Additionally, direct observation from the boat can reveal the reason for attending a non-formal environmental education session. Divers received a 35-minute briefing on diving skills to be practiced in shallow water, and on standard behaviour while on the reef. On the way to the dive site, perceptions are more active, and the chances of sighting any marine debris are much higher.

Participants were asked if during their excursion to the dive site, they noticed any marine debris; only 23% sighted some in the water, and 77% did not see any or were not focused on sighting it (see Figure 4.19).

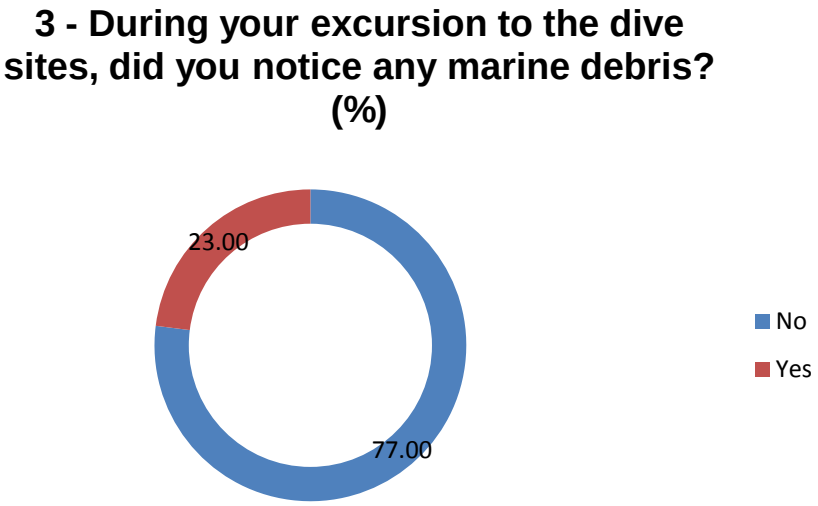


Figure 4.19: Register of how many students saw marine debris while diving, registered in survey 2 (Mota, 2013).

Cozumel Island was reported to be very clean; only during the hurricane season were some parts of the coastal area untidy, and throughout the year the current flowing in the channel carries away any debris. However, student divers reported some debris found near the shore:

- Broken up shell,
- Cardboard,
- Clothes, bottles, shoes,
- Concrete, cables,
- Food wrappers, near the shore, bear bottle,
- Only 1 hem... looked like a cardboard box,
- Paper, wood,
- Plastic fork
- Plastic bag,
- Plastic bottle,
- Plastic cup,
- Plastic cup, sticker,
- Plastic cups in water,
- Plastic lumps,
- Plastic ring,
- Pop cans,
- Sinks, wire, tubes, tires,
- Small amount of trash,
- Small debris,

(Mota, 2013).

Such debris is typically produced by services to tourists at coastal areas. Also, the wind can play an important role in transporting garbage into the water. As a consequence of sighting marine debris or just because it is an interesting subject to talk about, only 12% of diving students registered that they had spoken to people about environmental problems (Figure 4.10). During the testing phase of the measurement tool, it was decided to introduce a cell to register what problems related to the environment divers' were talking about; however, divers were not so receptive to commenting so it was removed from the survey in a subsequent phase.

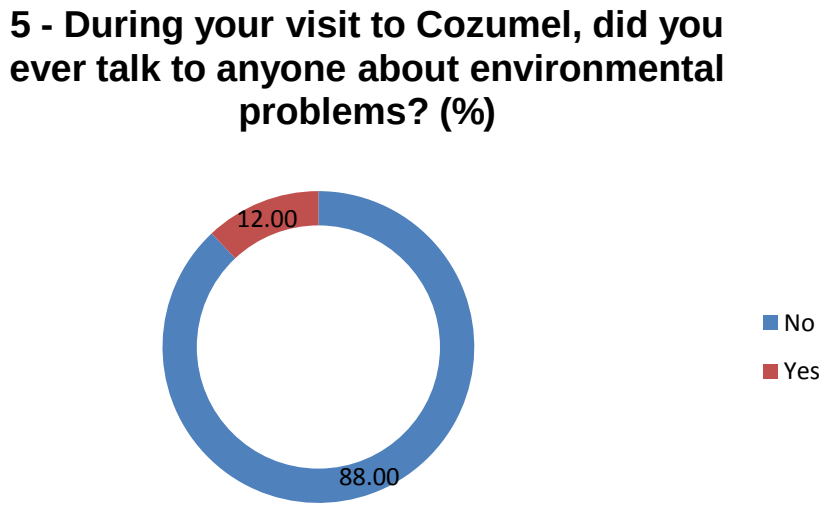


Figure 4.20: Percentage of divers talking about the environment during their visit to Cozumel, registered in survey 2 (Mota, 2013).

One last question for measuring environmental awareness from diving students was related to the coral reef and what benefits it can bring to local communities. Figure 4.21 visualizes all of the answers for comparison, where 52% of students actually realized that coral reefs can bring economic benefits to local communities as it provides job opportunities, investment in tourism-related facilities, a variety of service companies, and brings in currency, but the reef needs to be always respected and managed accordingly. The remaining 32% of students did not know the right answer, which is a high number, especially when

answers are sum to perception that coral reefs provide lots of art craft souvenirs made from real coral to sell to tourists. Moreover, if people answered all possible options it showed a big inconsistency in personal environmental awareness, and I would advise that it is better just to say “I don’t know the answer”.

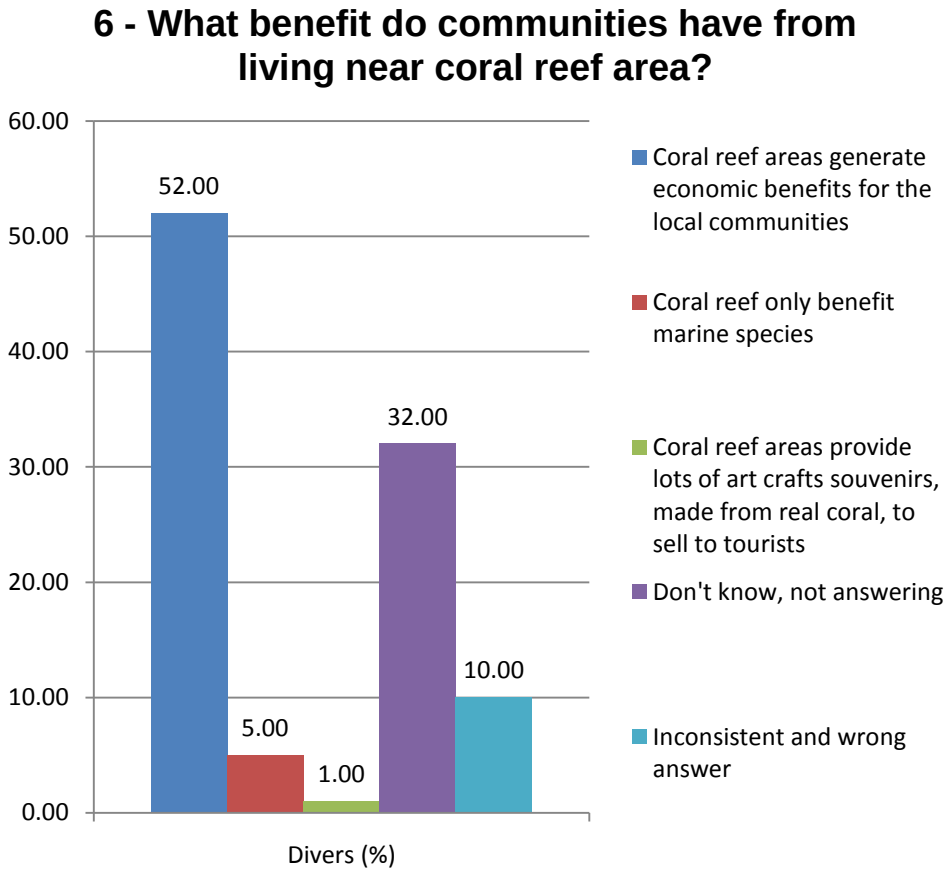


Figure 4.21: Awareness of coral reef areas, measured by divers, registered in survey 2 (Mota, 2013).

Only one participant used the field to describe other benefits that coral reef areas bring to local communities. Their answer is listed in Table 4.10, which demonstrates good environmental awareness and the importance of the coral reef in balancing the whole ecosystem.

Table 4.10: Other benefits registered from coral reefs, listed in survey 2.

6_1 - Other benefits			
		Frequency	Percent
Valid		99	99.00
	Coral reefs keep the ocean's ecological balance	**1**	1.00
	Total	100	100.00

Source: Mota, 2013.

4.5. Analysing the household attitude toward behaviour variable – HATB

For studying the variable HATB several arrays of statements were used where participants could rate each one based on a Likert-type scale, varying from “0 – I don’t know” to “5 – I do it always”. The entire collection of statements was tested for Cronbach’s alpha, which is recommended to be situated between 7.00 and 9.50 (George & Mallery, 2003). In the sample measured for all U.S. divers (n=181) the reliability given by Cronbach’s alpha for the 11 statements listed in survey1was 0.783, suggesting that the statements and respective Likert-type scale are acceptable for measuring the divers’ household attitudes toward behaviour.

The test also re-tests the array, giving a new value for alpha in case items are deleted, as illustrated in Table 4.11. A new relationship can increase or decrease the value for alpha, depending on the number of the items being measured or the level of correlation between different items. The high correlations tend the have a higher Cronbach’s alpha, providing reliability for the measurements. Overall, the 11 statements are good for measuring with the indicated scale; the alpha value decreases slightly, but is always above 0.70, However, if statement “4.4 – I compost my kitchen waste” was removed, Cronbach’s alpha would increase from 0.783 to 0.792, which is an indication that the item could be removed (see Table 4.11).

Table 4.11: Cronbach's alpha provided by the item-Total statistics for survey 1.

Survey 1 Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
4.1 - I buy things that are produced with as little packaging as possible.	24.15	32.661	.512	.340	**.758**
4.2 - I use my own bag when going shopping, rather than one provided by the shop.	24.40	30.308	.575	.355	**.748**
4.3 - I buy fruit and vegetables without packaging.	23.45	34.760	.358	.221	**.774**
4.4 - I compost my kitchen waste.	24.90	35.272	.215	.122	**.792**
4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	24.54	32.916	.548	.351	**.755**
4.6 - I purchase organic food.	24.22	34.037	.381	.294	**.772**
4.7 - I purchase bio-degradable products.	24.07	33.818	.478	.306	**.763**
4.8 - I look for ways to reuse things.	23.62	33.325	.486	.334	**.761**
4.9 - I recycle recyclable materials like newspapers, cans or bottles.	23.34	31.771	.494	.291	**.759**
4.10 -For shopping, I prefer paper bags to plastic ones.	24.09	32.386	.363	.256	**.778**
4.11 - I buy seasonal produce.	23.48	33.795	.471	.266	**.763**

Source: Mota, 2013.

Also in the inter-item correlation matrix listed in Appendix D, the correlations between statement 4.4 are below 0.200, with the exception when they are correlated with statement 4.5 (0.238), but removing item 4.4 does not increase the alpha that much as all items are always above 0.70, which is the acceptable range.

Survey 1used 11 statements for describing the variable HATB, which are numbered in Table 4.12 and the respective statistics describe the participants' observations for that variable. The table illustrates how well the participants described themselves based on the Likert-type scale developed for the measurement. The statements provided were affirmative for positive environmental practices regarding attitudes for handling food and plastic-related products.

After having confirmed the level of reliability of the scale used for measuring the statements (0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 – I do it often; 4 – I do it always), the comparison between the whole population of U.S. divers, diving students and certified divers reveals the differences among the groups. The overall sample describes the actual behaviour of the participants without distinction, while the subpopulation of certified divers provides the typical behaviour of divers regarding waste management practices in their household. Also student divers' adjusted behaviour is expected to be observed as a long-term impact of scuba diving activity.

The overall means are between the 1.53 and 3.08 points, represented by the majority of the lower ranks of the scale, where the standard deviation is also small (from 0.855 to 1.278), indicating how compact the sample is, comparatively to the mean value. The observations are not too spread and distant from the mean values. Moreover, the median and the modal values range from 1 to 4 points, representing the majority of the behaviour "I do it sometimes" and the extreme value "I do it always", with the exception of 1 point on the scale "I never do it", which was registered instatements 4.2 and 4.4. Also, it can be said that overall 25%of the general population only sometimes perform the behaviour or never do; 50% of participants have better behaviour, but can also do it always for statement 4.9. The remaining 25% has good overall performance for good environmental practices, performing the behaviour quite often, or always, but

Table 4.12: Statistics for the variable HATB, comparing the U.S. divers (n = 181), U.S. diving students (n = 100), and U.S. certified divers (n = 99) from survey 1.

	Sample	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11
Mean	All	2.28	2.03	2.98	1.53	1.88	2.21	2.36	2.8	3.08	2.33	2.94
	Stud.	1.99	1.69	2.90	1.53	1.71	2.14	2.17	2.63	3.00	2.10	2.86
	Cert.	2.66	2.39	3.08	1.56	2.09	2.33	2.62	3.01	3.27	2.59	3.07
Median	All	2	2	3	1	2	2	2	3	4	2	3
	Stud.	2	1	3	1	2	2	2	3	3	2	3
	Cert.	3	3	3	1	2	2	3	3	4	3	3
Mode	All	2	1	3	1	2	2	2	3	4	2	3
	Stud.	2	1	3	1	2	2	2	3	4	2	3
	Cert.	3	3	3	1	2	2	3	3	4	4	3
Std. Deviation	All	0.972	1.195	0.888	1.103	0.89	0.972	0.855	0.915	1.125	1.278	0.867
	Stud.	1.000	1.125	0.893	1.049	0.913	1.025	0.888	0.971	1.110	1.235	0.995
	Cert.	0.785	1.168	0.865	1.18	0.858	0.958	0.738	0.802	1.077	1.286	0.689
Percentile 25	All	2	1	3	1	1	2	2	2	2	1	2
	Stud.	1	1	2	1	1	1	2	2	2	1	2
	Cert.	2	1	3	1	2	2	2	2	3	2	3
Percentile 50	All	2	2	3	1	2	2	2	3	4	2	3
	Stud.	2	1	3	1	2	2	2	3	3	2	3
	Cert.	3	3	3	1	2	2	3	3	4	3	3
Percentile 75	All	3	3	4	2	2	3	3	3	4	3	4
	Stud.	3	3	4	2	2	3	3	3	4	3	4
	Cert.	3	3	4	2	3	3	3	4	4	4	4

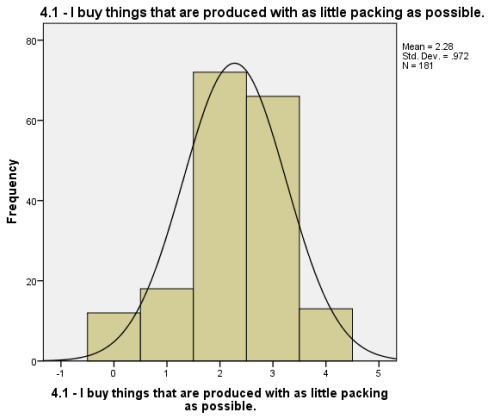
Scale: 0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 – I do it often; 4 – I do it always (Mota, 2013).

with the exception of statement 4.4 where only divers sometimes compost their kitchen waste, and statement 4.5 where divers sometimes assess the type of packaging and choose one that is recyclable.

I. Statement "4.1 - *I buy things that are produced with as little packaging as possible*".

The overall sample of U.S. divers, represented in Figure 4.22, presents a distribution with the majority of the answers concentrated between point 2 and point 3 of the scale, where the mean registers the value 2.28.

All U.S. divers



Diving students

Certified divers

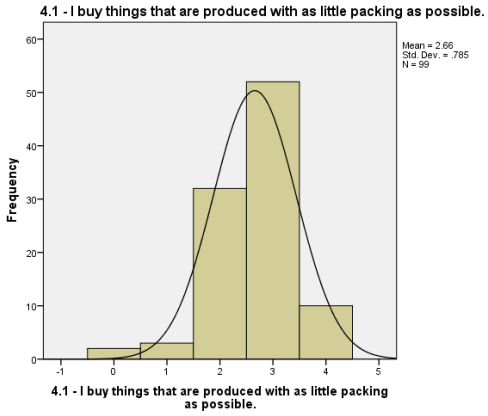


Figure 4.22: Comparison between diving students and certified divers measuring the statement 4.1 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

Listed in Table 4.12, percentile 50 gives the indication that 50% of the participants “never buy things that are produced with as little packaging as possible”, or “they do it sometimes”. Also, 25% of the participants “do it often”, or “do it always”, as indicated in percentile 75.

Analysing the distribution from diving students, the mean is 1.99 points with the peak at point 2 of the scale, having the majority of the values concentrated around the mean. The modal value is 2, indicating the more frequent behaviour “doing it sometimes”. Dividing the subpopulation, percentile 25 indicates that 25% of student divers never perform the behaviour, and the percentile 50 also indicates divers “never doing it”, or perhaps “doing it sometimes”, but 25% of diving students often buy “things that are produced with as little packaging as possible”.

The typical behaviour to compare arrives from the observations measured from certified divers, which present a mean of 2.66 for statement 4.1, and a median, modal, and percentile 50 of 3 points, indicating an accurate frequency in performing the behaviour.

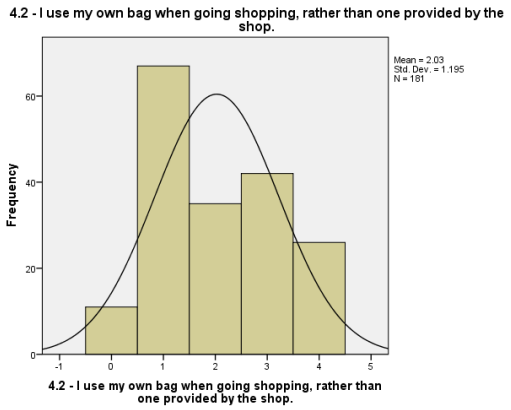
An overall comparison reveals that divers tend to behave different regarding “buying things that are produced with as little packaging as possible”; values describing the modal, median, and percentile 50 of the population in the study indicate divers perform the behaviour sometimes with the exception of certified divers who often perform statement 4.1. Percentile 25 indicates divers in general, and certified divers sometimes perform statement 4.1, with the exception of student divers who never do it. For the whole population, and subpopulations, 25% of the divers do it often, or they always buy things produced with as little packaging as possible”, as described by percentile 75.

II. Statement “4.2 –*I use my own bag when going shopping, rather than one provided by the shop*”.

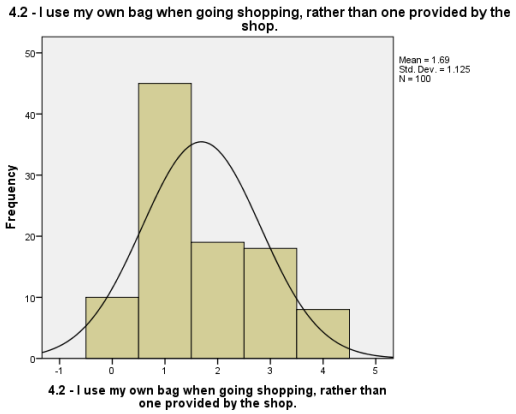
The overall sample of U.S. divers represented in Figure 4.23, has a scattered distribution of the sample, where values are quite spread around the mean (2.03), with the majority of answers concentrated between point 2 and point 4, with a peak at point 1 on the scale, where divers never “use their own bag when going shopping, rather than the one provided by the shop”. This

statement has three different distributions, one characterized by percentile 25 where participants never do it, or they don't know the answer; percentile 50 where participants do it sometimes, or never do it, and percentile 75 comprising 25% of participants doing it often, or behaving always like in the statement.

All U.S. divers



Diving students



Certified divers

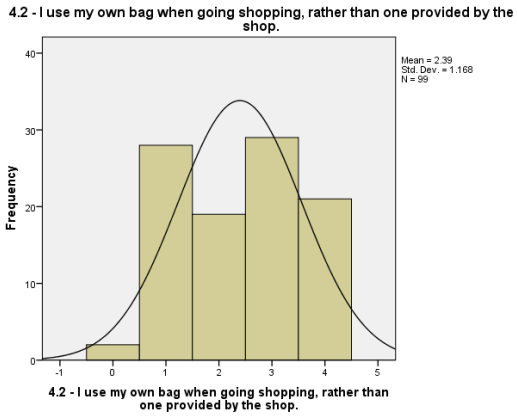


Figure 4.23: Comparison between diving students and certified divers measuring statement 4.2 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

Diving students display different behaviour as their mean value on the rating scale is much lower (1.69), and the median and modal value are also low. The distribution is well spread showing a standard deviation of 1.125, but with a high peak for students performing the behaviour only sometimes. Percentile 25 and 50 register divers as never performing the behaviour measured, although

25% of student divers display an opposite behaviour by often “using their own bag when going shopping, rather than one provided by the shop”.

The typical behaviour from certified divers indicates high values for performing the behaviour. The mean value is 2.39 and the median and modal value is 3, indicating that certified divers often “use their own bag when going shopping, rather than the one provided by the shop”, and 75% of the subpopulation also performs the same way or does it always.

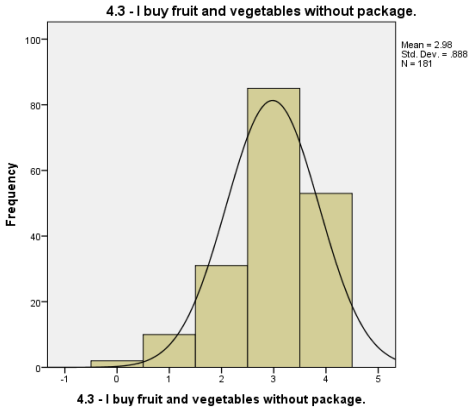
An overal comparison, brings diffences inthe median and modal numbers, extreming with not performing the behaviour from item 4.2, and doing it often. Percentile 25 indicates that 25% of the divers never do it, or actually they didnot know how to answer, but also 25% of the population in the study do it often or always “use their own bag when going shopping, rather than one provided by the shop”, as described by percentile 75.

III. Statement “*4.3 – I buy fruit and vegetables without packaging*”.

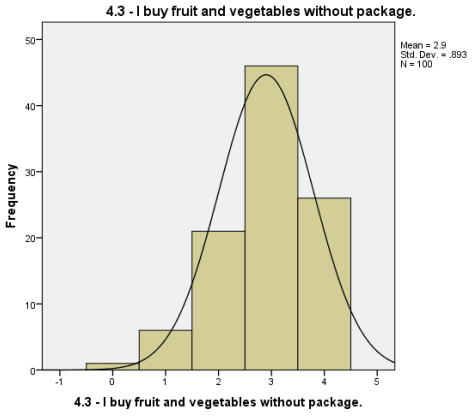
The overall sample of U.S. divers, represented in Figure 4.24, has a distribution with a high number of participants answering around the mean value (2.98), being the majorities on the right side of the mean value. However, it shows the tendency for skewing with values in the negative direction. Through percentile 50 it is clear that half of the participants are “buying fruit and vegetables without packaging” quite often, and 25% are doing it always as indicated by percentile 75.

All samples present very similar behaviour, which is thatdivers buy “often fruit and vegetables without packaging”, and 25% of the participants doing it always as indicated by percentile 75.

All U.S. divers



Diving students



Certified divers

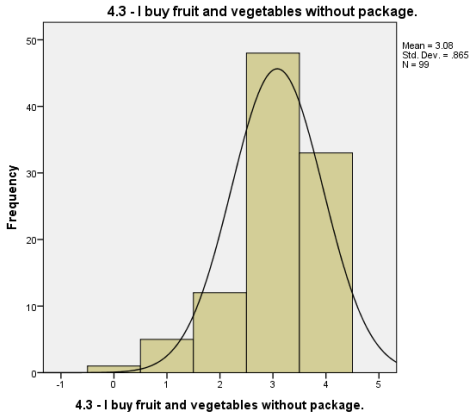
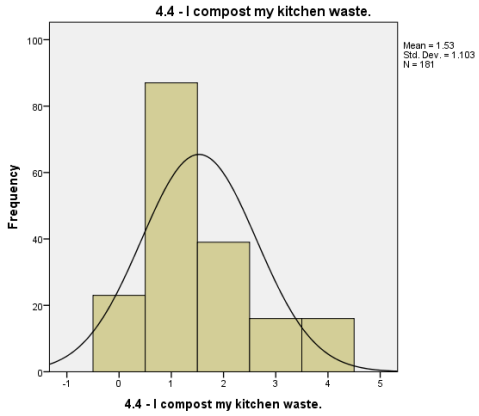


Figure 4.24: Comparison between diving students and certified divers measuring statement 4.3 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

IV. Statement "*4.4 – I compost my kitchen waste*".

Statement 4.4, represented in Figure 4.25, has its peak at point 1 of the scale, indicating the low frequency for performing the behaviour, and is on the left side of the mean value. The big majority of divers (75%) never compost their kitchen waste, as their mean is around 1.53 points, the median, mode, percentiles25 and 50 are represented by point 1 of the scale, although their observations are quite spread around the mean value, given by the standard deviations (1.049 to 1.180), and percentile 75 indicating 25% of divers, composting their kitchen waste sometimes, often or even always.

. **All U.S. divers**



Diving students **Certified divers**

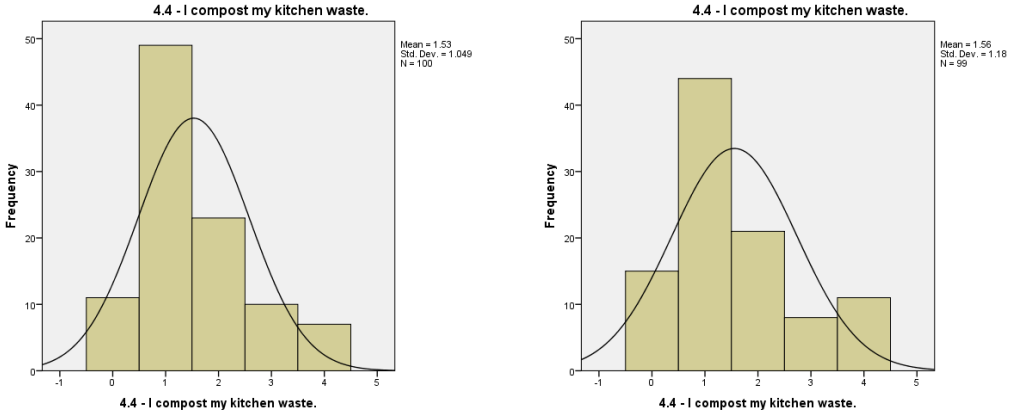


Figure 4.25: Comparison between diving students and certified divers measuring statement 4.4 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

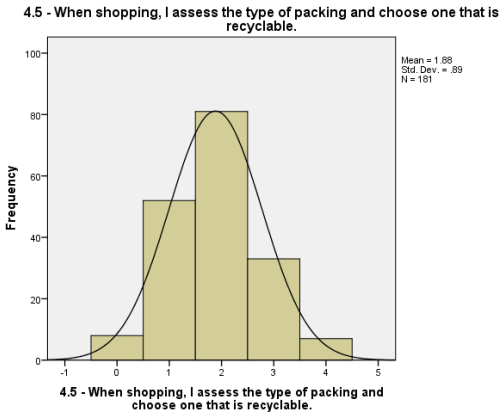
For kitchen waste all divers (students and certified) registered very similar behaviour.

V. Statement "*4.5 – When shopping, I assess the type of packaging and choose one that is recyclable*".

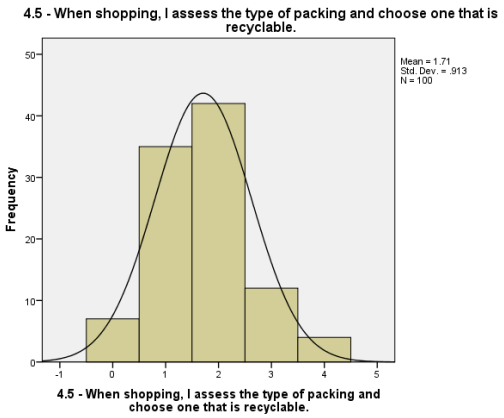
Figure 4.26 represents the distributions for statement 4.5, where the populations in the study have a mean ranging from 1.71 to 2.09, indicating the average for performing the behaviour. Also the median, and modal value

indicates the same type of behaviour, but registering percentile 25 with student divers, and the overall population never “assessing the type of packaging and choosing one that is recyclable”, with the exception of certified divers who do it sometimes. Moreover, the rest of the divers do it often, with the exception of certified divers who are always “assessing the type of packaging and choosing one that is recyclable” in percentile 75.

All U.S. divers



Diving students



Certified divers

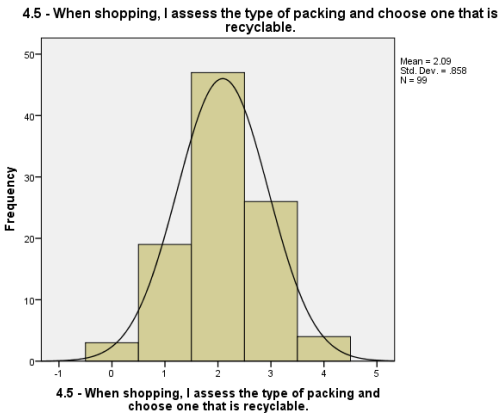
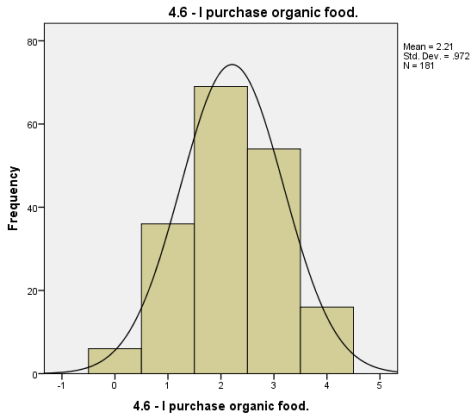


Figure 4.26: Comparison between diving students and certified divers measuring statement 4.5 using the Likert-type scale “0 – I don’t know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always” (Mota, 2013).

VI. Statement "*4.6 – I purchase organic food*".

Figure 2.27 represents the distributions of statement 4.6, where the mean values are very similar, ranging from 2.14 to 2.33 points of the scale, and the median and modal values also around 2 points, where divers sometimes purchase organic food. The samples are not so spread from the mean value, as the standard deviations range from 0.958 to 1.025 points, where percentile 25 also indicates the same type of behaviour with the exception of the student divers who never purchase organic food. Percentile 50 already indicates that divers sometimes perform the behaviour, having the remaining 25% of the population in the study buying it often or always, as indicated by percentile 75.

All U.S. divers



Diving students **Certified divers**

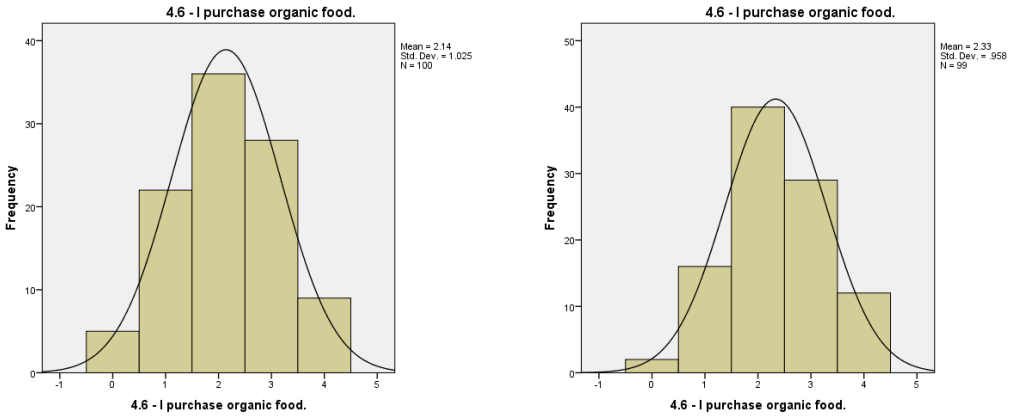
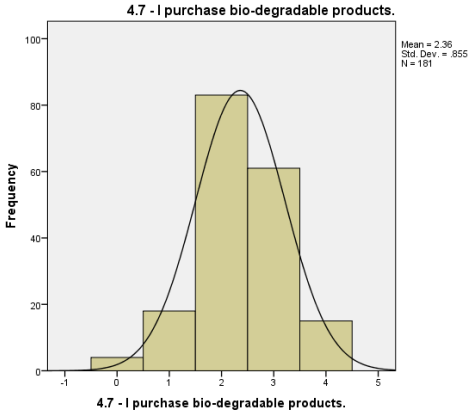


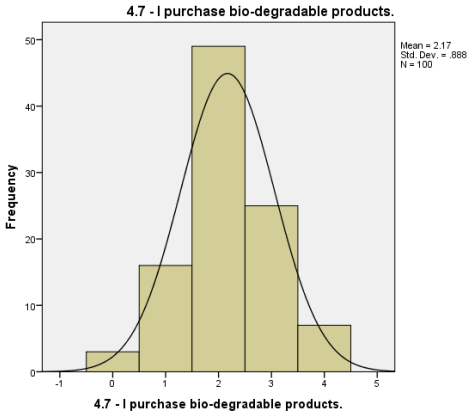
Figure 4.27: Comparison between diving students and certified divers measuring statement 4.6 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

VII. Statement "*4.7 – I purchase bio-degradable products*".

All U.S. divers



Diving students



Certified divers

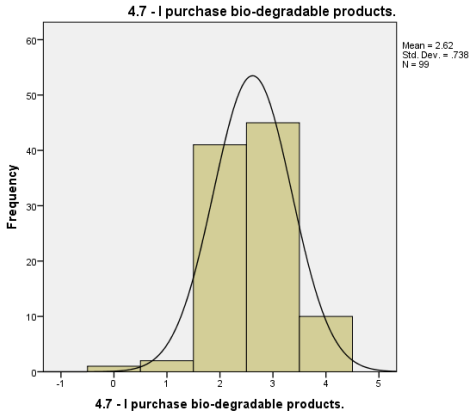


Figure 4.28: Comparison between diving students and certified divers measuring statement 4.7 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

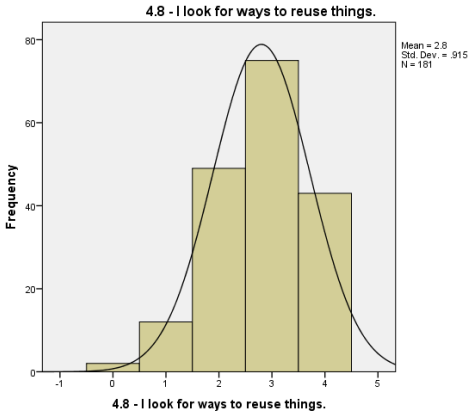
The distributions for statement 4.7 are illustrated in Figure 2.28, where the majority of the observations are inside the bell-shaped curve, and the mean values are ranging from 2.17 to 2.62. The median and modal value represents points2 and 3 of the scale, where divers sometimes purchase bio-degradable products, or often. The samples are concentrated around the mean, as the standard deviation is represented by values ranging from 0.738 to 0.888, and

percentile 25 indicates divers not performing the behaviour, or sometimes. 50% of the divers only sometimes perform the behaviour, with the exception of certified divers who registered doing it often, and 25% divers performing it often or always, as per percentile 75.

VIII. Statement "*4.8 – I look for ways to reuse things*".

Figure 2.29 illustrates the distributions for statement 4.8, where the mean values vary from 2.63 to 3.01, but their median and modal values represent 3 points on the scale, where divers often "look for ways to reuse things". Percentile 25 indicates 25% of divers perform the behaviour only sometimes, or never, and percentiles 50 and 75 have divers "looking for ways to reuse things" sometimes, or quite often, with the exception of certified divers on percentile 75 where 25% do it always.

All U.S. divers



Diving students **Certified divers**

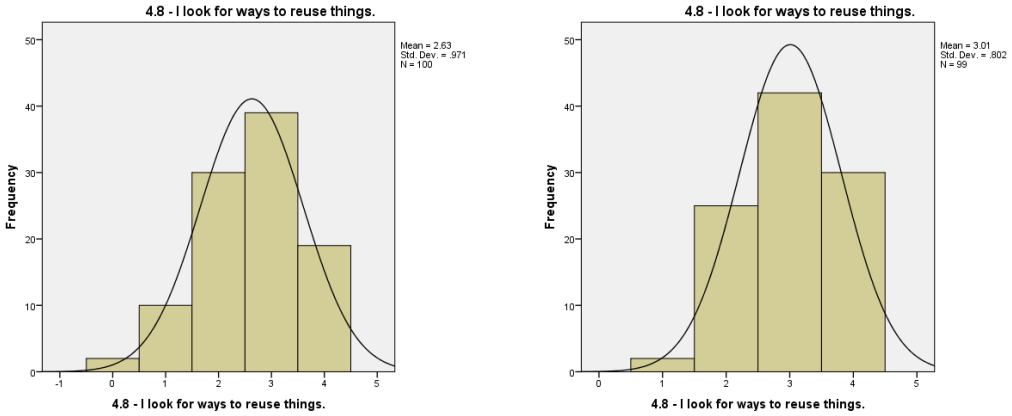


Figure 4.29: Comparison between diving students and certified divers measuring statement 4.8 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

IX. Statement "*4.9 – I recycle recyclable materials like newspaper, cans or bottles*".

Figure 4.30 illustrates the distributions for statement 4.9, where the mean values are very similar, ranging from 3.00 to 3.27, displaying a median value of 4 points for divers always performing the behaviour, with the exception of student divers, who do it only often. The observations tend to be well spread around the mean values, ranging from 1.077 to 1.125, as indicated by the standard deviation, but having some discrepancies when divided through the percentile.

All U.S. divers

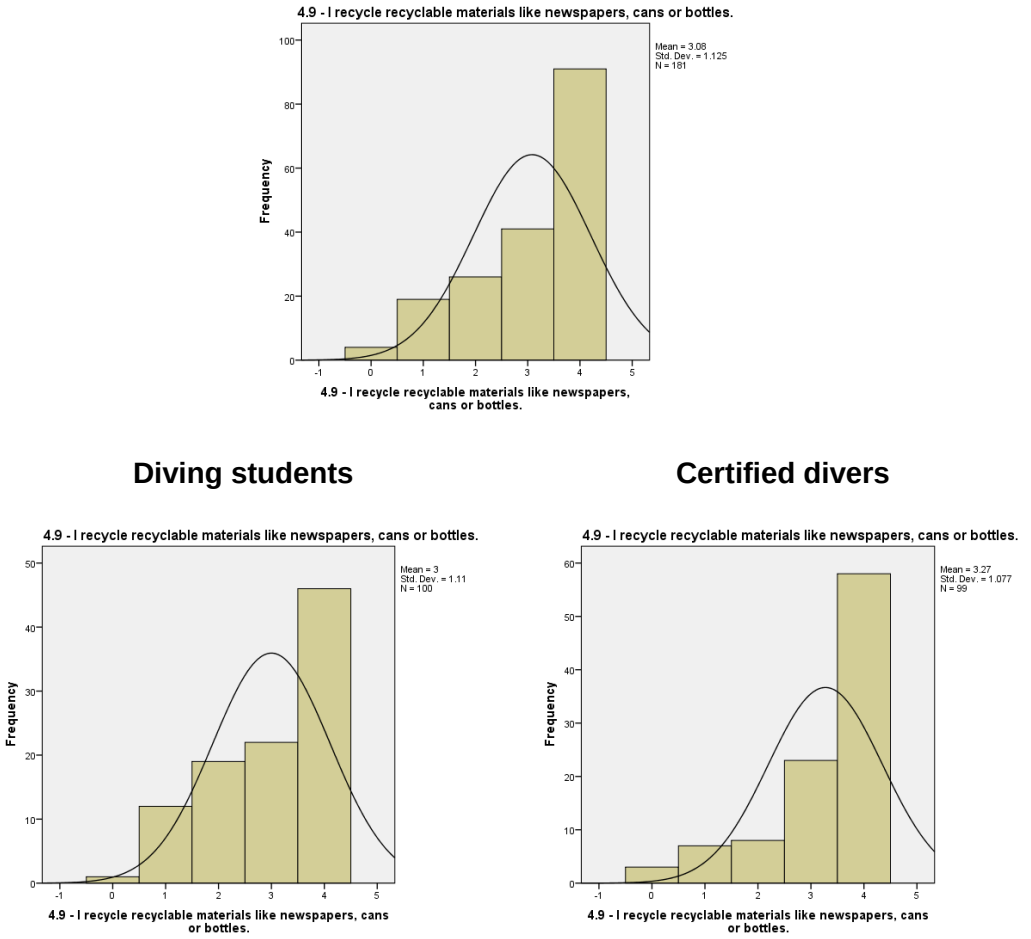


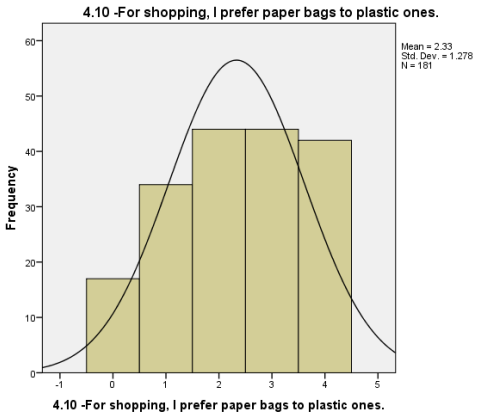
Figure 4.30: Comparison between diving students and certified divers measuring statement 4.9 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

25% of the population only sometimes "recycle recyclable materials like newspaper, cans or bottles, as per percentile 25, but having an exception with certified divers who do it often. Percentiles 50 and 75 indicate that divers often perform the behaviour, or always, with the exception of percentile 50 where student divers only perform the behaviour often.

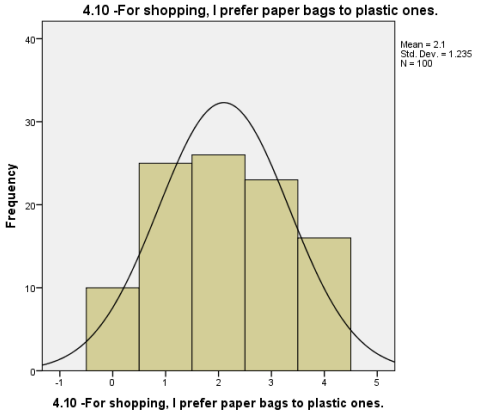
All distributions are negatively skewed, as the peak is located at point 4 of the scale for always performing the behaviour, and the tail is pulled towards the left side of the curve.

X. Statement "*4.10 – For shopping, I prefer paper bags to plastic ones*".

All U.S. divers



Diving students



Certified divers

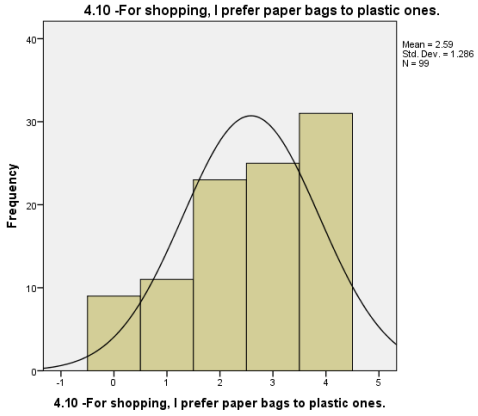


Figure 4.31: Comparison between diving students and certified divers measuring statement 4.10 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 - I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

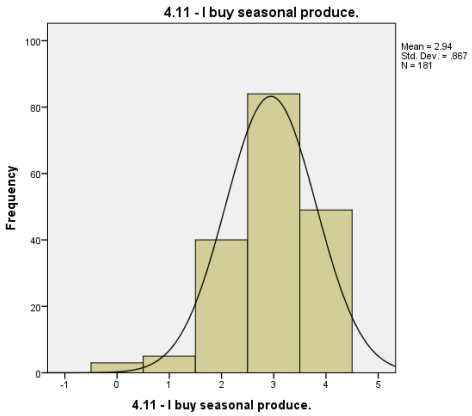
Figure 4.31 illustrates the distributions for statement 4.10, which have a mean value ranging from 2.10 to 2.59, and a median and modal value of 2 for the overall distribution and diving students. Certified divers present a median of 3 points of the scale, and modal number of the scale is 4, always performing the behaviour. The observations are well spread from the mean values, giving a

standard deviation from 1.235 to 1.286, giving also different percentiles. For shopping, 25% of the total divers and diving students do not know, or never "prefer paper bags to plastic ones", and already certified divers sometimes prefer paper bags. In percentile 50 only certified divers sometimes, and often, prefer paper bags to plastic ones, whereas diving students only do sometimes. Also for shopping, 25% of divers always prefer paper bags to plastic ones, but student divers only sometimes.

XI. Statement "*4.11 – I buy seasonal produce*".

Figure 2.32 illustrates the distributions for statement 4.11, where the mean values range from 2.86 to 3.07, and the median and modal values are situated on point 3 of the scale. All observations are quite close to the mean values, having the standard deviation ranging from 0.689 to 0.995, and only percentile 25 being different among the subpopulations; only sometimes do 25% of divers "buy seasonal produce" with the exception of certified divers doing it often, as indicated by percentile 25.

All U.S. divers



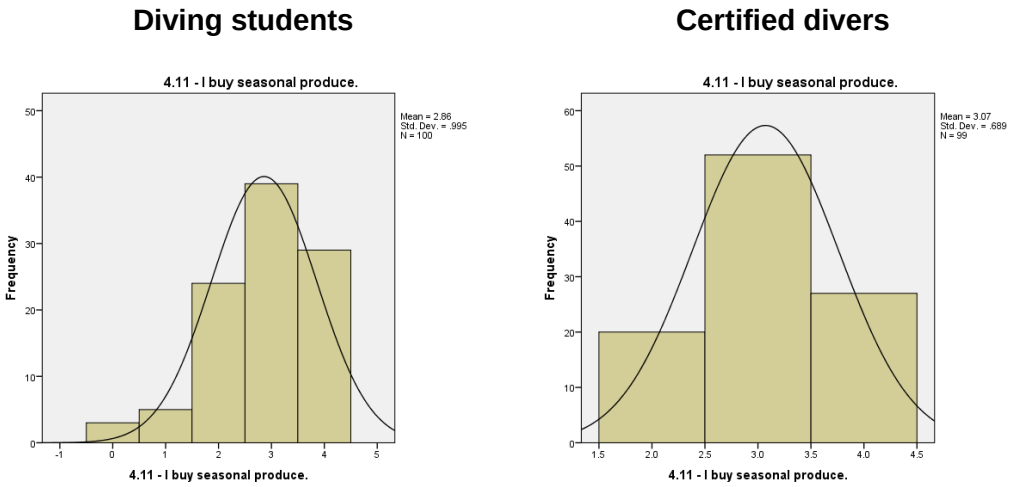


Figure 4.32: Comparison between diving students and certified divers measuring statement 4.11 using the Likert-type scale "0 – I don't know; 1 – I never do it; 2 - I do it sometimes; 3 - I do it often; 4 – I do it always" (Mota, 2013).

Percentile 50 has similar behaviour regarding divers "buying often seasonal produce", and percentile 75 indicates 25% of the divers always performing the behaviour. As stated before, there is a noticeable difference between diving students and certified divers with higher-scaled behaviour. In this study certified divers display a role-model profile, and diving students, being widely represented by non-certified divers, were classified as citizens without influence from scuba diving. Furthermore, the finding matches Kip Viscusi, Huber, and Bell's (2010, p.1) study, in which from a representative sample of U.S. household behaviours for plastic recycling, it was concluded that "individual behaviours that benefit the environment are potentially influenced by personal values of environmental quality, social norms that encourage pro-environmental actions, and economic incentives".

The second phase of the study

A second survey was administered only to students (n=100), with a set of 10 items for registering the consumption of products related to plastic and food discards while visiting Cozumel. The scale was composed of natural numbers, and the same procedure was followed for testing the reliability of the instrument,

obtaining Cronbach's alpha of 0.841. The item-total statistics table a reduction of the alpha can be observed if the items are removed, with the exception of item 4.10 which asks participants to list other items consumed while on the island, increasing the alpha from 0.841 to 0.852 (see Table 4.13). Again the increase was not that significant and all items were kept for measurement.

Table 4.13: Cronbach's alpha provided by the item-Total statistics for survey 2.

Survey 2 Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
4.1 - Plastic bags.	4.15	43.583	.775	.692	.800
4.2 - Plastic cups.	4.53	50.918	.523	.446	.828
4.3 - Styrofoam cups.	4.63	53.266	.476	.476	.833
4.4 - Packages of cigarettes.	4.70	56.475	.319	.248	.843
4.5 - Food containers.	4.44	47.380	.752	.695	.808
4.6 - Plastic bottles.	3.65	38.533	.825	.746	.792
4.7 - Drinking straws.	4.07	43.399	.632	.580	.819
4.8 - Beer bottles.	4.11	46.564	.512	.502	.832
4.9 - Batteries - AA, AAA, C&D, 6V, 9V, etc.	4.63	53.831	.400	.288	.838
4.10 - Other products consumed while on Cozumel:	4.83	59.799	.027	.061	.852

Source: Mota, 2013.

Altogether, the mean value of the scale statistics was 4.86 items, with a standard deviation of 7.739 items spread from the mean value of the population in the study. The items were selected based on a general list from Project

AWARE, which are commonly found as marine debris around the world, and also being common items consumed when visiting Cozumel Island.

The overall consumption of products on Cozumel Island is overrepresented by day visitors, who arrived by cruise ship and participated in day diving experiences. Do to the discover scuba diving activity being scheduled every day in the morning, at the time the survey was taken tourists had just left their ship after eating breakfast so not many consumed goods could be registered. However, some did register some items, and also divers staying overnight on the island registered their consumption.

The mean value is very low, ranging from 0.03 to 1.21, which is a strong indication that almost no items were consumed at the time of the survey; on the other hand, the sample is well spread from the mean value as the standard deviation ranges from 0.171 to 1.777. Despite the median and modal values being zero, items like “4.1. Plastic bags” reached 28 items, “4.6. Plastic bottles” 44 items, “4.7. Drinking straws” 24 items, and “4.9. Batteries AA, AAA, C & D, 6V, 9V, etc.” 9 items. The recorded percentiles are almost all equal to zero on the scale, but items 41 and 4.8 were sometimes consumed, often or always by 25% of the population in the study, according to percentile 75. Also item 4.6 was registered for 25% of the population in being consumed sometimes, often or always.

Cozumel Island is a day-party island where millions of tourists like to enjoy the atmosphere of the local people, gastronomy, alcohol, and the all-inclusive in some beach clubs. Items related to plastic are permanently consumed while partying, and food containers are taken to hold meals consumption during excursions and also plastic water bottles for avoiding dehydration. For most visitors, time is very short for enjoying the island, and the following items will give a closer description of the impact created by the tourists on potential marine debris.

The mean value is very low, ranging from 0.03 to 1.21, which is a strong indication that almost no items were consumed at the time of the survey; on the other hand, the sample is well spread from the mean value as the standard deviation ranges from 0.171 to 1.777. Despite the median and modal values being zero, items like “4.1. Plastic bags” reached 28 items, “4.6. Plastic bottles” 44 items, “4.7. Drinking straws” 24 items, and “4.9. Batteries AA, AAA, C & D, 6V, 9V, etc.” 9 items. The recorded percentiles are almost all equal to zero on

the scale, but items 41 and 4.8 were sometimes consumed, often or always by 25% of the population in the study, according to percentile 75. Also item 4.6 was registered for 25% of the population in being consumed sometimes, often or always (see Table 4.14).

Table 4.14: Observations from survey 2, for describing the amount of products consumed on Cozumel Island by diving students.

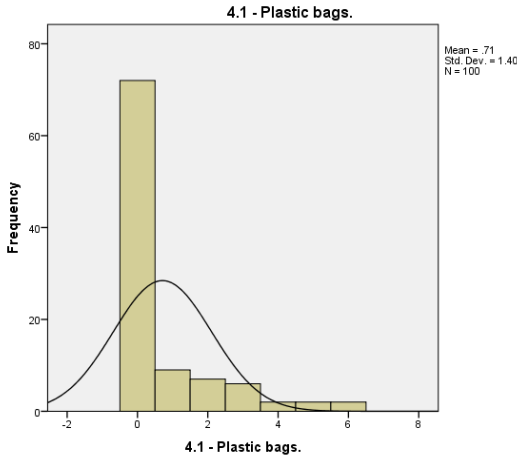
n = 100	Mean	Median	Mode	Std. Deviation	Min	Max	Sum	Percentiles		
								25	50	75
4.1 - Plastic bags.	0.71	0.00	0	**1.402**	0	**6**	**28**	0.00	0.00	**1.00**
4.2 - Plastic cups.	0.33	0.00	0	1.055	0	**6**	**14**	0.00	0.00	0.00
4.3 - Styrofoam cups.	0.23	0.00	0	0.851	0	**6**	**10**	0.00	0.00	0.00
4.4 - Packages of cigarettes.	0.16	0.00	0	0.631	0	4	**8**	0.00	0.00	0.00
4.5 - Food containers.	0.42	0.00	0	1.093	0	**6**	**17**	0.00	0.00	0.00
4.6 - Plastic bottles.	1.21	0.00	0	**1.777**	0	**6**	**44**	0.00	0.00	**2.00**
4.7 - Drinking straws.	0.79	0.00	0	**1.653**	0	**6**	**24**	0.00	0.00	0.00
4.8 - Beer bottles.	0.75	0.00	0	**1.559**	0	**6**	**27**	0.00	0.00	**1.00**
4.9 - Batteries - AA, AAA, C&D, 6V, 9V, etc.	0.23	0.00	0	0.897	0	**6**	**9**	0.00	0.00	0.00
4.10 - Other products consumed while on Cozumel:	0.03	0.00	0	0.171	0	1	**2**	0.00	0.00	0.00
4.10_1 - What products?	0.03	0.00	0	0.171	0	1	**2**	0.00	0.00	0.00

Source: Mota, 2013.

Chapter 4

I. Item “4.1 – Plastic bags”.

Plastic bags are associated with most purchases in our life, but it would be surprising on Cozumel, where 78% of visitors are staying for just 1 day that they would strongly contribute to the 28 plastic bags consumed; in percentile 75, the majority of diving students did not consume any.



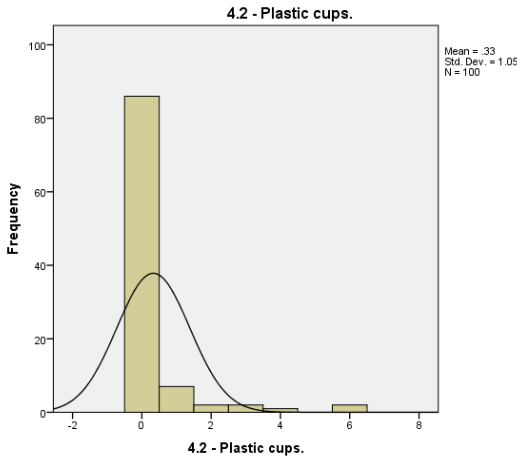
	4.1 - Plastic bags.		
	Scale	Frequency	Percent
Valid	0	72	72.00
	1	9	9.00
	2	7	7.00
	3	6	6.00
	4	2	2.00
	5	2	2.00
	+ 5	2	2.00
	Total	100	100.00

Figure 4.33: The consumption of plastic bags by diving students while visiting Cozumel Island (Mota, 2013).

In Figure 4.33, the distribution of items consumed by diving students shows a positive skew, over-representing the majority of zero consumptions, leaving the tail towards the participants staying overnight on Cozumel, and allowing some of them to consume plastic bags. 0 to 5 items were measured on the scale, leaving open the registry for more then 5, which was coded 6, and could be 6 or 10, or 20 plastic bags, although only 2 participants reached such levels of the scale.

II. Item “4.2 - Plastic cups”.

Figure 4.34 gives the distribution for plastic cups, which represent a single-use item or takeaway drinks. Regarding the fact that the majority of the surveys were administered in the morning, and sometimes in the afternoon, diving students consumed 14 plastic cups, with the majority representing the 0 point on the scale, skewing the curve to the right side of the mean value. Also, only 2 participants registered consumption of more than 5 plastic cups during their stay on the island (six).

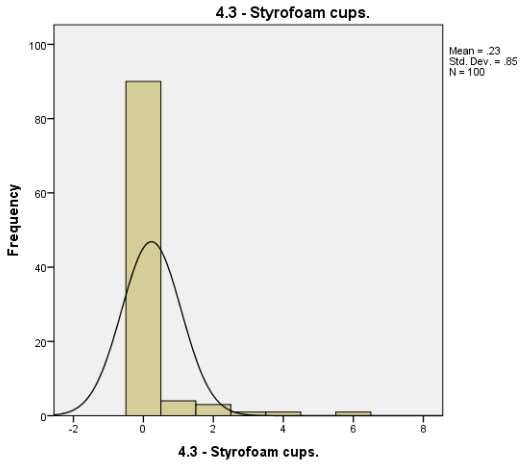


4.2 - Plastic cups.

	Scale	Frequency	Percent
Valid	0	86	86.00
	1	7	7.00
	2	2	2.00
	3	2	2.00
	4	1	1.00
	+ 5	2	2.00
	Total	100	100

Figure 4.34: The consumption of plastic cups by diving students while visiting Cozumel Island (Mota, 2013).

III. The item"4.3 – Styrofoam cups".



4.3 - Styrofoam cups.

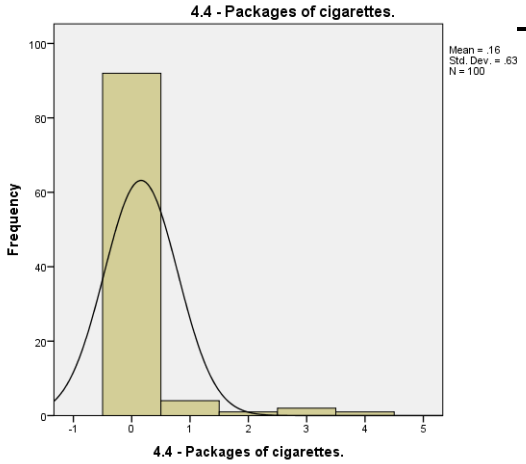
	Scale	Frequency	Percent
Valid	0	90	90.0
	1	4	4.0
	2	3	3.0
	3	1	1.0
	4	1	1.0
	+ 5	1	1.0
	Total	100	100.0

Figure 4.35: The consumption of Styrofoam cups by diving students while visiting Cozumel Island (Mota, 2013).

Figure 4.35 illustrates the distribution for the item "Styrofoam cups" which are also result of takeaway drinks, or for serving regular drinks in local businesses. During the whole fieldwork, a total of 10 cups were consumed, and again modal values register divers not consuming the item.

IV. Item "4.4 – Packages of cigarettes".

Figure 4.36 illustrates the distribution of packs of cigarettes, where the modal number registers student divers as not consuming while on the island, although scattered events occurred for registering the total of 8 packages while on the island.

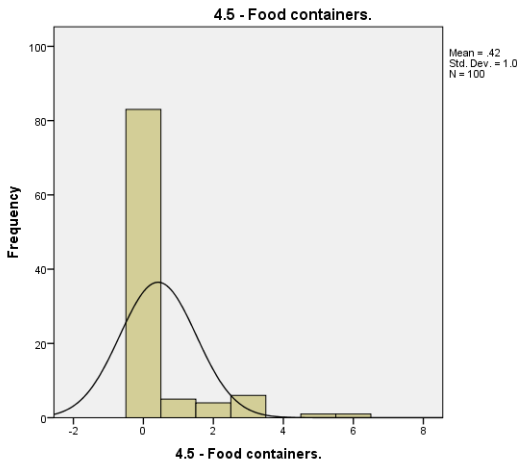


4.4 – Packages of cigarettes.

	Scale	Frequency	Percent
Valid	0	92	92.0
	1	4	4.0
	2	1	1.0
	3	2	2.0
	4	1	1.0
	Total	100	100.0

Figure 4.36: The consumption of packages of cigarettes by diving students while visiting Cozumel Island (Mota, 2013).

V. Item "4.5 – Food containers".



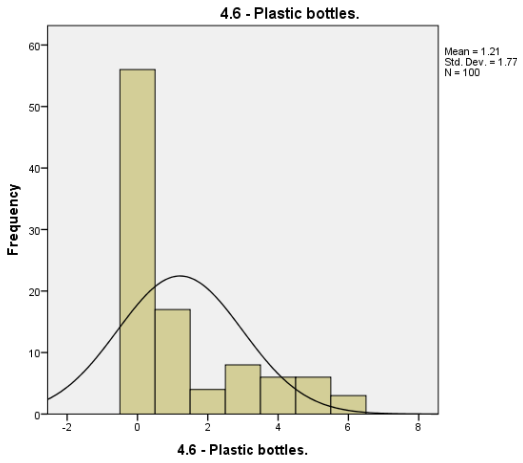
4.5 – Food containers.

	Scale	Frequency	Percent
Valid	0	83	83.0
	1	5	5.0
	2	4	4.0
	3	6	6.0
	5	1	1.0
	+ 5	1	1.0
	Total	100	100.0
	0	83	83.0

Figure 4.37: The consumption of food containers by diving students while visiting Cozumel Island (Mota, 2013).

Figure 4.37 illustrates the distribution for food containers, presenting a well-spread distribution from the mean value, as per the standard deviation of 1.093. The distribution is skewed to the right side of the mean value, but registering a modal value equal to zero. The total of 17 food containers was consumed during students' visit to Cozumel Island.

VI. Item "4.6 – Plastic bottles".



4.6 – Plastic bottles.

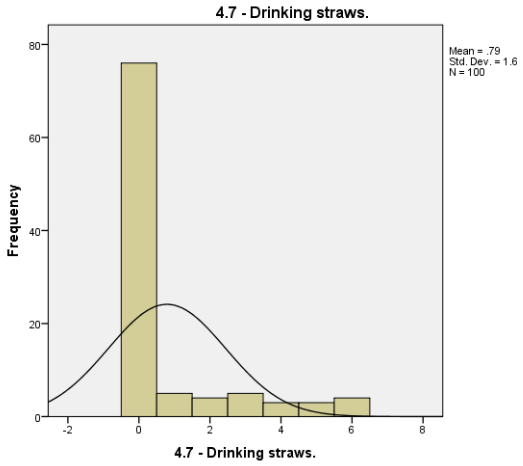
	Scale	Frequency	Percent
Valid	0	56	56.0
	1	17	17.0
	2	4	4.0
	3	8	8.0
	4	6	6.0
	5	6	6.0
	+ 5	3	3.0
	Total	100	100

Figure 4.38: The consumption of plastic bottles by diving students while visiting Cozumel Island (Mota, 2013).

The distribution for plastic bottles is represented in Figure 4.38, where the observations are widely spread from the mean value and only over 1 (1.21), as indicated by the standard deviation of 1.777. This item registered the most consumption by diving students, with 44 items in total. Percentile 75 indicates that 25% of the students consumed at least 2 plastic bottles, although the modal value registers a no consumption of the plastic bottles.

VII. Item “4.7 – Drinking straws”.

Figure 4.39 illustrates the distribution of drinking straws, which registers a standard deviation of 1.653 compared to the mean. The modal value indicates no consumption, but a maximum of 24 drinking straws was registered.



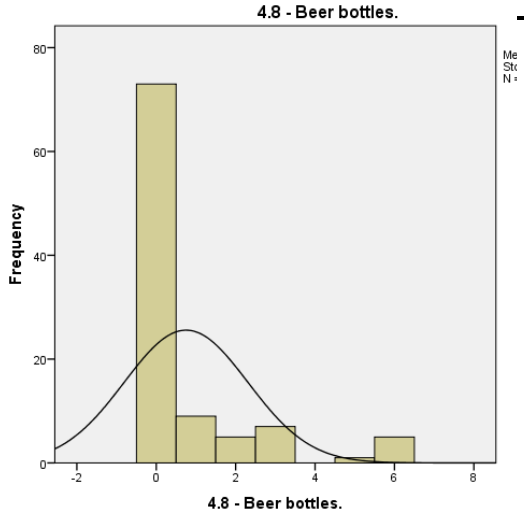
4.7 – Drinking straws.

	Scale	Frequency	Percent
Valid	0	76	76.0
	1	5	5.0
	2	4	4.0
	3	5	5.0
	4	3	3.0
	5	3	3.0
	+ 5	4	4.0
	Total	100	100.0

Figure 4.39: The consumption of drinking straws by diving students while visiting Cozumel Island (Mota, 2013).

VIII. Item “4.8 – Beer bottles”.

Figure 4.40 represents the skewed distribution for the consumption of 27 beer bottles. The number of observations is spread 1.559 from the mean value, as per the standard deviation, and the modal value indicates no consumption, although 25% of students consumed at least one beer bottle.



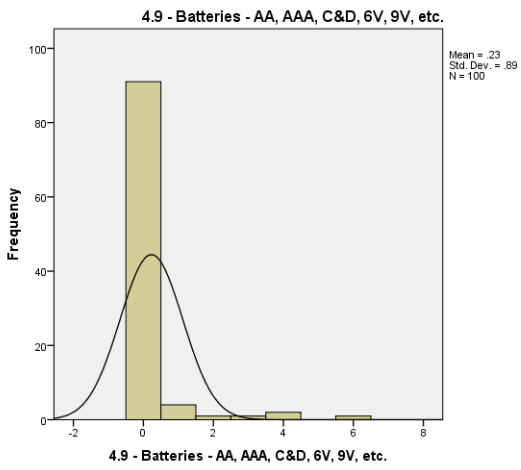
4.8 – Beer bottles.

	Scale	Frequency	Percent
Valid	0	73	73.0
	1	9	9.0
	2	5	5.0
	3	7	7.0
	5	1	1.0
	+ 5	5	5.0
	Total	100	100.0

Figure 4.40: The consumption of beer bottles by diving students while visiting Cozumel Island (Mota, 2013).

IX. Item "4.9 – Batteries - AA, AAA, C & D, 6V, 9V, etc."

Figure 4.41 illustrates the consumption of a total of 9 batteries by diving students. The distribution is skewed to the right of the mean value and also the median, modal and percentile indicates no consumption.

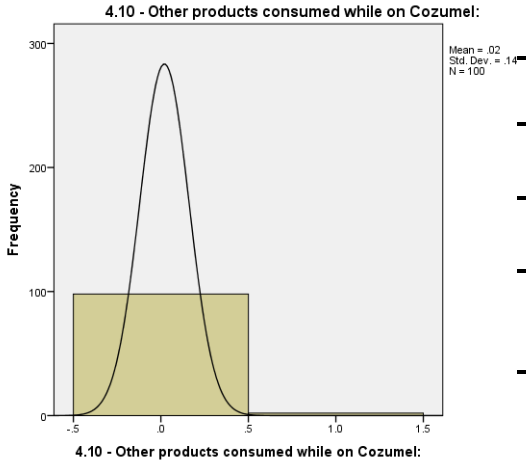


4.9 – Beer Batteries - AA, AAA, C & D, 6V, 9V, etc.

	Scale	Frequency	Percent
Valid	0	91	91.0
	1	4	4.0
	2	1	1.0
	3	1	1.0
	4	2	2.0
	+ 5	1	1.0
	Total	100	100.0

Figure 4.41: The consumption of batteries AA, AAA, C & D, 6V, 9V, etc. by diving students while visiting Cozumel Island (Mota, 2013).

X. Other items.



4.10 – Other products.

Valid	Scale	Frequency	Percent
	0	98	98.0
Cans	1	1	1.0
Paper cup		1	1.0
	Total	100	100.0

Figure 4.42: The consumption of other products by diving students while visiting Cozumel Island (Mota, 2013).

Figure 4.42 illustrates the distribution of other items consumed on Cozumel Island, in case it would apply. Only 2 students registered 1 can and 1 paper cup which were not listed in the set of marine-related items.

4.6. Analysing the perceived behaviour control variable – PBC

The variable for the perceived behaviour control was measured through a single statement, where divers are asked to answer affirmatively or negatively for "looking for recyclable products has become part of their routine". Divers' past attitudes and intention are reflected in the measured behaviour. When divers show the intention to perform certain behaviour for good environmental practices, their belief can also be described as an attitude for good environmental practices and consequent consumption of new resources, then

the variable should register negative actions. Despite this supposition, it must be said that a single measurement variable cannot be generalized for perceived behaviour control, but yes it can be used in the model for building clusters and could become a good prediction for the final achieved behaviour.

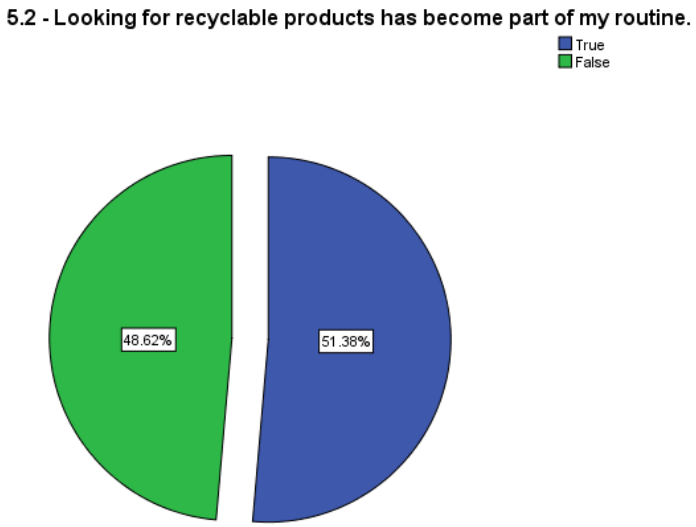


Figure 4.43: The variable PBC described through statement 5.2 in survey 1, registered by the entire population of U.S. divers (Mota, 2013).

The variable' strength is given by beliefs, attitudes, intentions and behaviour, and also by the perception of whether the behaviour can be performed, and how and when it can be accomplished. During fieldwork, divers' perception for "looking for recyclable products, becoming part of their routine", registered 51.38% of affirmative perception, and control of their behaviour for reducing their ecological footprint. Table 4.15 illustrates the differences among the different samples obtained, having the subsample for student divers achieving different values, only 46% of participants perform the PCB, while the typical behaviour, analysed among certified divers, has 61.62% of the participants "looking for recyclable products, as part of their routine".

Table 4.15: Comparison for the variable PBC.

# 5.1	All		Students		Certified	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
True	93	**51.38**	46	**46.00**	61	**61.62**
False	88	48.62	54	54.00	38	38.38
Sample	181	100	100	100	99	100

Source: Mota, 2013.

By comparing diving students with their role model (certified divers), a comparison can be done by using Table 4.16 and listing statements that can be directly related to “looking for recyclable products”, confirming PBC:

- “4.2 I use my own bag when going shopping, rather than the one provided by the shop”.
- “4.5 When shopping, I assess the type of packaging and choose one that is recyclable”.
- “4.8 I look for ways to reuse things”.
- “4.9 I recycle recyclable products like newspaper, cans or bottles”.

The values for behaviour performance are completely different among all subsamples; regarding statement 4.2, the mean value ranges from 1.69 to 2.03, with students never performing the behaviour, and certified divers doing it often.

Table 4.16: Statistics for the variable HATB in confirmation of PBC, comparing the U.S. divers (n = 181), U.S. diving students (n = 100), and U.S. certified divers (n = 99) from survey 1.

	Sample	4.2	4.5	4.8	4.9
Mean	All	2.03	1.88	2.8	3.08
	Stud.	1.69	1.71	2.63	3.00
	Cert.	2.39	2.09	3.01	3.27
Median	All	2	2	3	4
	Stud.	1	2	3	3
	Cert.	3	2	3	4
Mode	All	1	2	3	4
	Stud.	1	2	3	4
	Cert.	3	2	3	4
Std. Deviation	All	1.195	0.89	0.915	1.125
	Stud.	1.125	0.913	0.971	1.110
	Cert.	1.168	0.858	0.802	1.077
Percentile 25	All	1	1	2	2
	Stud.	1	1	2	2
	Cert.	1	2	2	3
Percentile 50	All	2	2	3	4
	Stud.	1	2	3	3
	Cert.	3	2	3	4
Percentile 75	All	3	2	3	4
	Stud.	3	2	3	4
	Cert.	3	3	4	4

Scale: 0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 – I do it often; 4 – I do it Always (Mota, 2013).

The mean value for the whole population was 2, and the mode 1. Percentiles 25 and 50 also have students never performing the behaviour, and certified divers doing it often, and 25% of all divers doing it often.

Regarding statement 4.5 the mean is even lower (1.88), but when going shopping, sometimes divers assess the type of packaging and choose one that is recyclable, indicated by the median and mode number, although 25% of participants do it often or always, as indicated by percentile 75.

Regarding statement 4.5 the mean ranges from 1.71 to 2.39, with a median and mode of 2 points on the scale. Divers differ in percentiles 25 and 75, where students always have one point lower on the scale, comparing to certified divers. Percentile 50 indicates all divers performing the behaviour sometimes.

Regarding statement 4.8, the mean value ranges from 2.63 to 3.01, also register better behaviours for the median, mode, and percentile, which indicate that only 25% of the population do not perform the behaviour, or do it sometimes. The remaining participants do it often, and certified divers always perform the behaviour (percentile 75).

Regarding statement 4.9, the mean value ranges from 3.00 to 3.27, indicating good performance for the behaviour (doing it often), likewise the median, mode and percentile, having 25% of participants always recycling recyclable products like newspapers, cans or bottles.

Another variable used for clustering is the subjective norm indicated by the statement “5.1 – Most people I know contribute to help the environment”. As mentioned in Chapter 4, this variable has the purpose of testing if it can be included in the proposed model only if it becomes significant when creating clusters. Table 4.17 illustrates the comparison for the obtained samples:

Table 4.17: Comparison for subjective norms of the three samples.

# 5.2	**All**		**Students**		**Certified**	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
True	116	**64.09**	58	**58.00**	73	**73.74**
False	65	**35.91**	42	**42.00**	26	**26.26**
Sample	181	100	100	100	99	100

Source: Mota, 2013.

Overall, the groups of divers analysed indicated affirmative answers regarding knowing people who help the environment, which according to the TPB is an indication and predictor for divers' behaviour.

4.7. Predicting household behaviour using SPSS two-step cluster analysis

The two-step cluster analysis was performed using the variables listed in the proposed model for the study of environmental behaviour in the divers' household. The set of variables representing AWARE, HATB, and PBC were entered into SPSS 20, represented by statements "*1.1 - I am a member of an environmental organization*", "*4.5 - When shopping, I assess the type of packaging and choose one that is recyclable*", and the "*5.2 – Looking for recyclable products has become part of my routine*". The log-likelihood method was used as a distance measure, and the Schwarz's Bayesian Criterion (BIC) was selected for forming clusters. Furthermore, setting the algorithm to handle 25% noise reduced possible outliers.

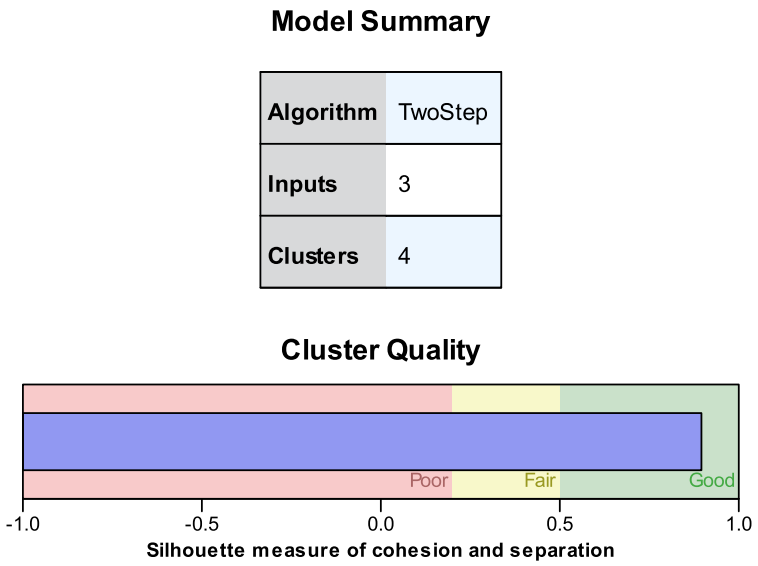
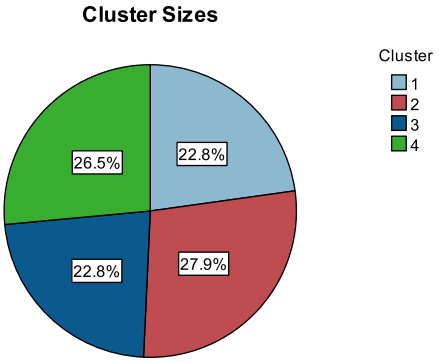


Figure 4.44: Model summary for the variables AWARE, HATB, and PBC,represented by statements 1.1, 4.5, and 5.2 (Mota, 2013).

The number of clusters to be determined automatically was set at a maximum of 4, aside from the combination chosen for field evaluation using the variables "*2.2 - What diving courses are you taking*" and "*3.1 – What is your certification level*". These variables were not used to form clusters, but the software rated the clusters regarding the evaluation fields.

Figure 4.4 illustrates the model summary for the 4 clusters formed by using the combination of 3 different variables, reaching a good fit level of 0.90. The smallest cluster has 31 members (22.8%) and the largest 38 (27.9%), with1.23 as ratio size when comparing the largest cluster to the smallest (see Figure 4.45).



Size of Smallest Cluster	31 (22.8%)
Size of Largest Cluster	38 (27.9%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	1.23

Figure 4.45: Distribution of the clusters formed by using entry variables 4.1, 4.5, and 5.2 (Mota, 2013).

The criterion for finding dissimilarities between variables which form clusters was provided by Mooi and Sarstedt (2011), who recommended using correlations below0.90 for predicting the importance of the cluster. Furthermore,

the rule of thumb set the cluster size to at least 30 members, with a ratio between clusters smaller than 3.0. Clusters formed with the variable set should not be 3 times bigger between clusters.

On Figure 4.46, the correlations are represented by statement 4.5 on top, correlated with statement 5.2 at 0.71. With clear evidence, these two variables were used to form clusters, annulling the hypothesis of AWARE, represented by membership of an environmental organization to be decisive or having importance for forming clusters. The last two entries were not used to form clusters, but represent the field evaluation when deciding for clusters.

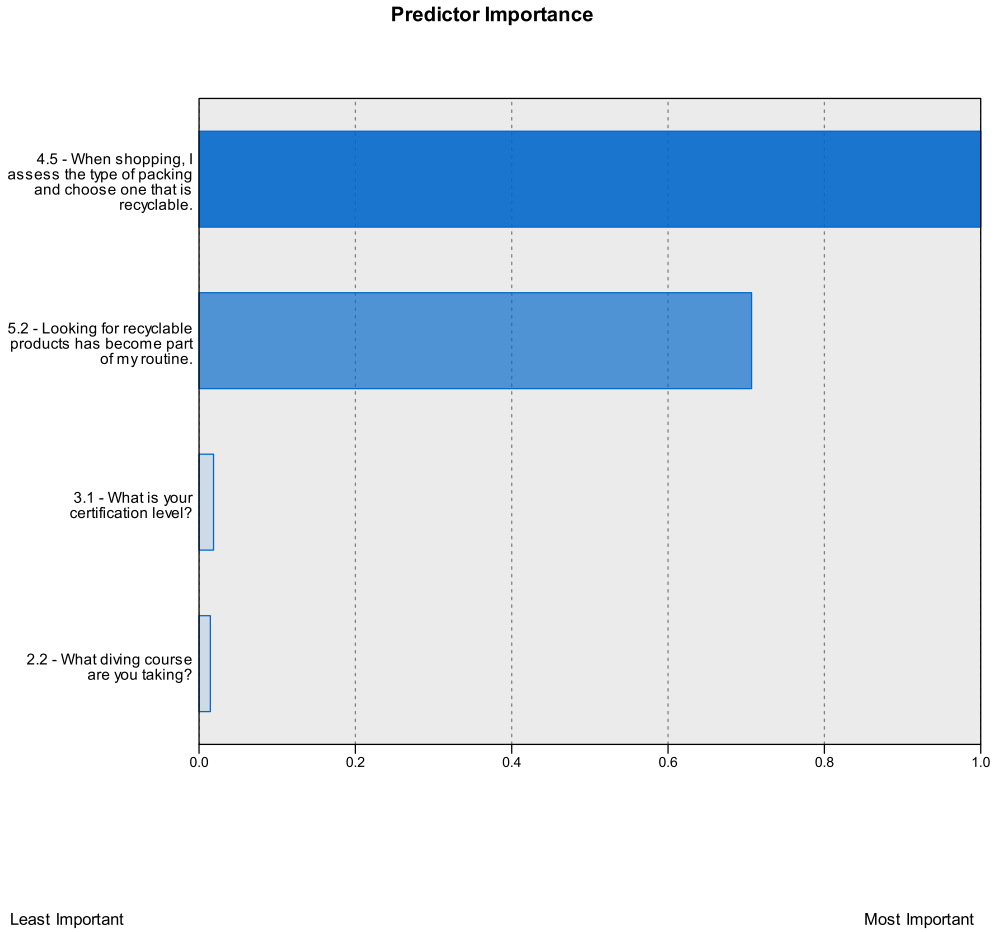


Figure 4.46: Cluster comparison through the respective predictor importance level between AWARE, HATB, and PBC (Mota, 2013).

The variable AWARE, described to reduce bias, was used in survey 1, and kept until the end of the fieldwork. Figure 4.46 proves that at this level membership of an environmental organization is not relevant for forming clusters for behavioural change in the divers' household. The clusters have quite a similar size (see Table 4.18), differing in the importance of input, shifting among 1.1 and 5.2, reporting respective evaluation of the participants by course level and diving certification.

Table 4.18: Input importance for forming each cluster using AWARE, HATB, and PBC (Mota, 2013).

Clusters

Input (Predictor) Importance

1.0 0.8 0.6 0.4 0.2 0.0

Cluster	1	2	3	4
Label				
Description				
Size	22.8% (31)	27.9% (38)	22.8% (31)	26.5% (36)
Inputs	4.5 - When shopping, I assess the type of packing and choose one that is …	5.2 - Looking for recyclable products has become part of my routine.	5.2 - Looking for recyclable products has become part of my routine.	4.5 - When shopping, I assess the type of packing and choose one that is …
	5.2 - Looking for recyclable products has become part of my routine.	4.5 - When shopping, I assess the type of packing and choose one that is …	4.5 - When shopping, I assess the type of packing and choose one that is …	5.2 - Looking for recyclable products has become part of my routine.
	1.1 - I am a member of an environmental organization.	1.1 - I am a member of an environmental organization.	1.1 - I am a member of an environmental organization.	1.1 - I am a member of an environmental organization.
Evaluation Fields	2.2 - What diving course are you taking?	2.2 - What diving course are you taking?	2.2 - What diving course are you taking?	2.2 - What diving course are you taking?
	3.1 - What is your certification level?	3.1 - What is your certification level?	3.1 - What is your certification level?	3.1 - What is your certification level?

Cluster 1 is formed by 64.5% of participants who, when going shopping, often assess the type of packaging and choose one that is recyclable, correlated

with the totality of divers (100%) who respond positively to the PBC where “looking for recyclable products has become part of their routine”. All formed clusters are correlated with the low importance predictor of not being a member of an environmental organization, which is a statement that did not contribute to forming any cluster, even among participants who answered positively.

Evaluating the cluster based on the diving course taken, 45.2% of the students integrating cluster 1, were taking the SD course (code 1 for SPSS), and also 38.7 of the certified divers held the OWD certification level (code 2 for SPSS).

Cluster 2 is formed with the totality of participants who answered positively to the variable PBC (statement 5.2), and all divers who, only sometimes assess the type of packaging and choose one that is recyclable when going shopping. The level of the certified divers integrating such clusters was 42.1% with DM (code 6 on SPSS), and using diving courses for evaluation, the cluster is comprised mostly by students participating in SD level courses.

Cluster 3 is composed of all participants who answered negatively to the PBC variable, and divers who perform the behaviour stated in item 4.5. Diving students comprise this cluster with 51.6% of an AOWD level course (code 3 on SPSS), and if evaluated by diver certification, divemasters represent 72.2% of the cluster.

Cluster 4 is composed of all participants who never assess the type of packaging when going shopping, and divers who answered negatively to the PBC variable. When evaluating by course level, students taking the AOWD represent 61.1% of the cluster, and when evaluating by certified divers, 72.2% of the participants were holding DM level.

Figure 4.47 gives a clear distribution of the clusters formed, offering a comparison between clusters. Divers integrating the first cluster often perform the behaviour of looking for recyclable products as part of their routine, although they do not have any memberships of environmental organizations. Also when evaluating by course level and diving level, participants were taking the scuba diver course, or if already certified, they had the OWD level.

In cluster 2, participants only sometimes perform the behaviour of assessing the packaging by choosing the one that is recyclable, but looking for recyclable products has become part of their routine. Also they do not have a membership of an environmental organization, and could be evaluated as taking

entry-level diving courses such as SD, or if already certified divers, they tend to be highly certified with at least DM level.

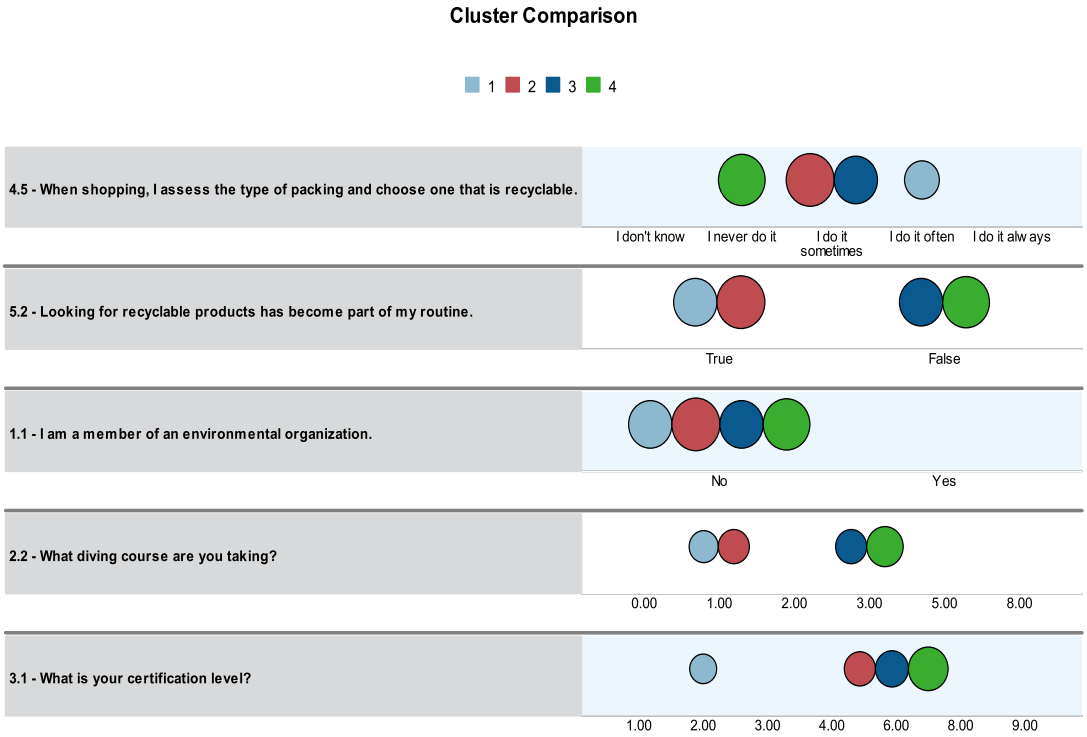


Figure 4.47: Custer comparison for entries 1.1, 4.5, and 5.2 (Mota, 2013).

In cluster 3, divers only sometimes perform the behaviour and never look for recyclable products as part of their routine. Not holding any memberships, they can be differentiated into divers taking entry-level courses such as SD, or when already certified, those holding high levels of certification (DM).

In cluster 4, participants never perform the behaviour, they do not look for recyclable products, do not hold any memberships, but are already divers engaging in continuing-education diving courses such as the AOWD.

4.7.1. Validating and interpreting the clusters' solution

Regarding the fact that variables are categorical, for validating the solution it is recommended to run, for example, a cross-tabulation for measuring the dissimilarity of the clusters formed. The Chi-square test is a goodness-of-fit test comparing "observed and expected frequencies in each category to test that all categories contain the same proportion of values, or test that each category contains a user-specified proportion of values" (IBM SPSS, 2011, p. 233). In this case, clusters were tested for adequate proportion of members, and the level of independence of the variables was evaluated.

For performing the test, assumptions must be checked for analysing the random data, having for each category a minimum of at least 1 expected frequency. In cross-tabulations bigger than 2 x 2, the categories must have at least 5 expected frequencies, and when it does not verify the criteria, no more than 20% of the categories can have fewer than 5 expected frequencies.

Table 4.19: Case processing summary cross-tabulation for AWARE, HATB, and PBC.

Case Processing Summary	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
1.1 - I am a member of an environmental organization. * Two-Step Cluster Number	181	100.0%	0	0.0%	181	100.0%
4.5 - When shopping, I assess the type of packaging and choose one that is recyclable. * Two-Step Cluster Number	181	100.0%	0	0.0%	181	100.0%
5.2 - Looking for recyclable products has become part of my routine. * Two-Step Cluster Number	181	100.0%	0	0.0%	181	100.0%

Source: Mota, 2013.

Table 4.19 provides a summary of the variables related with the previously created cluster membership number; the Pearson's Chi-square test verifies the independence of the variables and dissimilarity of the clusters

formed. For executing the test, there is the assumption that variable 1.1 and the clusters formed are not related, where values of the dependent variable (cluster number) are not affected at all by the independent variables (AWARE, HATB, and PBC). The hypothesis for testing will be accepted or rejected according to the value of significance of the test.

Null Hypothesis: There is no association between the clusters formed and the independent variables.

Alternative Hypothesis: The clusters formed and the independent variables are associated.

Analysing 1.1 - I am a member of an environmental organization. * Two-Step Cluster Number.

Table 4.20: Cross-tabulation for AWARE and the cluster membership.

Crosstab			Two-Step Cluster Number					Total
			Outlier Cluster	Cluster 1	Cluster 2	Cluster 3	Cluster 4	
1.1 - I am a member of an environmental organization.	**No**	Count	18	31	38	31	36	154
		Expected Count	38.3	26.4	32.3	26.4	30.6	154.0
		% within 1.1 - I am a member of an environmental organization.	11.7%	20.1%	24.7%	20.1%	23.4%	100.0 %
	Yes	Count	27	0	0	0	0	27
		Expected Count	6.7	**4.6**	5.7	**4.6**	5.4	27.0
		% within 1.1 - I am a member of an environmental organization.	100.0%	0.0%	0.0%	0.0%	0.0%	100.0 %
Total		Count	45	31	38	31	36	181
		Expected Count	45.0	31.0	38.0	31.0	36.0	181.0

	% within 1.1 - I am a member of an environmental organization.	24.9%	17.1%	21.0%	17.1%	19.9%	100.0 %

Source: Mota, 2013.

The term asymptotically refers to sufficient sample size, which is not verified for analysing the clusters generated, registering expected results less than 5 observations (see Table 4.20). The variable level “No” has considerable differences between the observed and the expected frequencies, confirming dependency of the cluster on the variable AWARE, where the size of the cluster correlated with the value of the independent variable. Moreover, the variable level “Yes” has two cells with expected frequencies less than 5, for verifying the independence of the variables, Pearson’s Chi-square test (X^2) is no longer suitable, with it being recommended to use Fisher’s Exact Test. Instead of an asymptotic test for computing the algorithm, the Monte Carlo exact test was selected for providing an estimate of the exact *p* value, using the random sample of 181 participants, with a confidence level of 95%.

Table 4.21: Pearson’s Chi-square and Fisher’s exact test for the cross-tabulation for AWARE, and the clusters formed.

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)	Monte Carlo Sig. (2-sided)		
				Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pearson’s Chi-Square	95.906[a]	4	.000	.000[b]	.000	.016
Likelihood Ratio	91.928	4	.000	.000[b]	.000	.016
Fisher's Exact Test	**79.387**			**.000[b]**	.000	.016
Linear-by-Linear Association	68.195[c]	1	.000	.000[b]	.000	.016
N of Valid Cases	181					

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 4.62.

b. Based on 181 sampled tables with starting seed 839511668.

b. The standardized statistic is -8.258.

Source: Mota, 2013.

From the 181 divers, participating in the study, and despite variable 1.1 not being important for forming clusters, Fisher's exact test reveals statistical significant evidence that the formed clusters also depend on the variable 1.1 ($F = 79.387$, $p < 0.05$). Based on Table 4.20, and by rejecting the null hypothesis, Fisher's exact test confirms the dependency of the formed clusters on not being a member of an environmental organization.

Analysing 4.5 - When shopping, I assess the type of packaging and choose one that is recyclable. * Two-Step Cluster Number.

Table 4.22: Cross-tabulation for the clusters formed and the variable HATB on a Likert-type scale.

Crosstab			Two-Step Cluster Number					Total
			Outlier Cluster	Cluster 1	Cluster 2	Cluster 3	Cluster 4	
4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	**I don't know**	Count	8	0	0	0	0	8
		Expected Count	**2.0**	**1.4**	**1.7**	**1.4**	**1.6**	8.0
		% within 4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	100.0%	0.0%	0.0%	0.0%	0.0%	100.0 %
	I never do it	Count	5	11	0	0	36	52
		Expected Count	12.9	8.9	10.9	8.9	10.3	52.0
		% within 4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	9.6%	21.2%	0.0%	0.0%	69.2%	100.0 %
	I do it somet	Count	12	0	38	31	0	81
		Expected Count	20.1	13.9	17.0	13.9	16.1	81.0

	imes	% within 4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	14.8%	0.0%	46.9%	38.3%	0.0%	100.0 %
	I do it often	Count	13	20	0	0	0	33
		Expected Count	8.2	5.7	6.9	5.7	6.6	33.0
		% within 4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	39.4%	60.6%	0.0%	0.0%	0.0%	100.0 %
	I do it always	Count	7	0	0	0	0	7
		Expected Count	**1.7**	**1.2**	**1.5**	**1.2**	**1.4**	7.0
		% within 4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	100.0%	0.0%	0.0%	0.0%	0.0%	100.0 %
Total		Count	45	31	38	31	36	181
		Expected Count	45.0	31.0	38.0	31.0	36.0	181.0
		% within 4.5 - When shopping, I assess the type of packaging and choose one that is recyclable.	24.9%	17.1%	21.0%	17.1%	19.9%	100.0 %

Source: Mota, 2013.

Table 4.22 illustrates the cross-tabulation for the clusters formed and variable 4.5, where the Likert-type scale was used for describing the participant's attitude toward the behaviour. In the table the behaviour "I don't know", and "I do it always" which registered expected counts lower than 5, were notorious, requiring the use of Fisher's exact test for understanding the relation between the variable and the clusters formed.

Table 4.23: Pearson's Chi-square and Fisher's exact test for the cross-tabulation of for HATB, and the clusters formed.

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)	Monte Carlo Sig. (2-sided)		
				Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pearson's Chi-Square	272.868[a]	16	.000	.000[b]	.000	.016
Likelihood Ratio	287.753	16	.000	.000[b]	.000	.016
Fisher's Exact Test	**248.129**			**.000[b]**	.000	.016
Linear-by-Linear Association	24.224[c]	1	.000	.000[b]	.000	.016
N of Valid Cases	181					

a.10 cells (40.0%) have expected count less than 5. The minimum expected count is 1.20.[a]

b. Based on 181 sampled tables with starting seed 839511668.[b]

c. The standardized statistic is -4.922.[c]

Source: Mota, 2013.

From the 181 divers participating in the study, and using a variable with an important predictor factor for forming clusters (1.0), Fisher's exact test (see Table 4.23) reveals statistically significant evidence that the clusters formed depend on the variable 4.5 ($F = 248.129$, $p < 0.05$). Based on Table 4.22 and by rejecting the null hypothesis, Fisher's exact test confirms the dependency of the clusters formed, and "never performing the behaviour", "do it sometimes", "do it often".

5.2 - Looking for recyclable products has become part of my routine. * Two-Step Cluster Number

Table 4.24 illustrates the cross-tabulation between the clusters formed and the PBC variable, which has at least 5 expected observations for each cell, and therefore provides conditions for using the X^2 test.

Table 4.24: Cross-tabulation for the clusters formed and the variable PBC.

Crosstab			Two-Step Cluster Number					Total
			Outlier Cluster	Cluster 1	Cluster 2	Cluster 3	Cluster 4	
5.2 - Looking for recyclable products has become part of my routine.	**True**	Count	24	31	38	0	0	93
		Expected Count	23.1	15.9	19.5	15.9	18.5	93.0
		% within 5.2 - Looking for recyclable products has become part of my routine.	25.8%	33.3%	40.9%	0.0%	0.0%	100.0%
	False	Count	21	0	0	31	36	88
		Expected Count	21.9	15.1	18.5	15.1	17.5	88.0
		% within 5.2 - Looking for recyclable products has become part of my routine.	23.9%	0.0%	0.0%	35.2%	40.9%	100.0%
Total		Count	45	31	38	31	36	181
		% within 5.2 - Looking for recyclable products has become part of my routine.	24.9%	17.1%	21.0%	17.1%	19.9%	100.0%

Source: Mota, 2013.

From the 181 divers participating in the study, and using a variable with an important predictor factor for forming clusters (0.71), Pearson's Chi-square test with 4 degrees of freedom (see Table 4.25) reveals statistically significant evidence that the clusters formed depend on the variable 5.2 ($X^2 = 136.166$, $p < 0.05$). Based on Table 4.24, and by rejecting the null hypothesis, Pearson's Chi-square test confirms the dependency of the clusters formed on the perceived

behaviour control “looking for recyclable products has become part of the divers’ routine”.

Table: 4.25: Pearson’s Chi-square test for the cross-tabulation of for PBC, and the clusters formed.

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)	Monte Carlo Sig. (2-sided)		
				Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Pearson’s Chi-Square	**136.166[a]**	**4**	.000	**.000[b]**	.000	.016
Likelihood Ratio	188.598	4	.000	.000[b]	.000	.016
Fisher's Exact Test	172.710			.000[b]	.000	.016
Linear-by-Linear Association	33.713[c]	1	.000	.000[b]	.000	.016
N of Valid Cases	181					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.07.

b. Based on 181 sampled tables with starting seed 839511668.

c. The standardized statistic is 5.806.

Source: Mota, 2013.

The stability of the formed clusters was tested by re-testing the same sample, using a different method for measuring the distances between the closest members to form clusters, based on Akaike’s Information Criterion (AIC) estimating the optimal number of clusters (Schiopu, 2010; Mooi & Sarstedt, 2011). Equal values were displayed for the number of clusters formed and respective sizes; the ratio between the largest and the smallest cluster is also equal, and when changing the order of the clusters formed, no differences were displayed. The new cluster membership variable was used in the same process, verifying the same solutions for the test of independence of the clusters and variables used.

Overall, the set of variables presented in the model can generate important clusters, featuring distinctions among the groups with different “qualities” for environmental practices toward the environment, in this case, for reducing plastic use and food waste (see Table 4.26 in Appendix I). In the whole sample, and due to the use of dichotomous variables combined with only one

Likert-type scale variable, clusters formed 2 to 4 different groups, containing variables with an important level for predicting behaviour. The fitness of the clusters was always good, but when using demographic variables, it decreased to a fair level, which was still acceptable.

Environmental awareness was demonstrated to be very important by always registering a high value for prediction importance, and therefore sustaining the hypothesis that education can contribute to environmental awareness and reduction of marine debris. The variable was combined with all the different variables in the model, and formed clusters with good level of fitness, except when combined with variables for diving. Perhaps the reason for this resides in the number of members that are automatically excluded when analysing the subpopulation of certified divers (n=99), and diving students (n=100).

Scuba diving has taken a central position for mediating important variables such as HATB, DEMO and PBC for environmental awareness and possible behavioural change, although it led to small cluster sizes with fewer than 30 members, which is not suitable for forming solid clusters. The level of fitness was always good, but probably due to the type of inputs an average of 2 clustering variables was revealed. Moreover, dissimilarity between clusters is statistically significant, with clusters depending on the variable set, but not sufficiently to affirm that DIVE itself, represents a very important prediction level for behavioural change.

When clustering for diving certification level, only 99 students could be used for clustering, disregarding 82 divers and reducing the number of members in the clusters. DIVE is best used as an evaluation field, providing an understanding of the percentage of diving courses within cluster members; the same practical information can also be obtained for certified divers.

The use of socio-demographic variables such as country location (question 6.1) where divers are living, and annual household income (question 6.7) was also revealed to be an important predictor, in particular when combined with attitudes and awareness. Socio-demographic variables such as living area (question 6.2), motivation (question 6.3), age (question 6.4), gender (question 6.5), or education (question 6.6) do not have a high prediction value when testing plastic and food discards in the household. The fitness index is reasonable, but generates clusters with fewer than 30 members.

Testing the variable for subjective norms revealed a potential for forming clusters, when combined with some variable sets was balanced in proportion for predictive importance, but not conclusive, as it can turn into a swamping variable. Also Table 4.26 contains the most significant and interesting set of variables for analysis, which can be representative of the population in the study.

4.8. The long-term impact measured for HATB in the divers' household

The qualitative instrument (web survey) was used to measure long-term impact for behavioural changes, by crossing information from the two previous surveys where scales were used to measure attitudes and consumption of goods. For measuring HATB in the web survey, the array of statements was used from survey 1 with the Likert-type scale and the scale of natural numbers used in survey 2 for measuring the number of items consumed while on Cozumel Island, but applied to the disposed items in the participants' household. In this set of items, the 9 items listed in Table 4.27 have an acceptable Cronbach's alpha of 0.727.

The inter-items correlation was still acceptable with few values below 0.200, and the item-total statistic listed in Table 4.27 showed that all items are important to keep for measurement, with the exception of item 5.2 "Yogurt plastic cups" and item 5.6 "beer bottles". The value for alpha decreased, probably due to the list having only 9 items which was one less than the previous exercise (see section 4.5); however, taking into account the small differences, and within the alpha's acceptable range, all items were kept for measurement, obtaining a scale mean of 8.8 items and 5.603 standard deviation from the mean of the population in the study.

The long-term impact was measured two to six months after the diving experience, looking for eventual changes and opinions provided by the participants regarding environmental awareness and behaviour related to plastic and food discards in the household (see appendix J). From a total of 236 participants, including students and certified divers of any nationality, 144 registered for the long-term personal study and received a personal email with clear instructions, and the respective code number with the link to the survey.

Table 4.27: Cronbach's alpha calculated through the item-total statistics for the web survey scale.

Web survey Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
5.1 - Plastic bags.	7.60	24.627	.492	.533	.687
5.2 - Yogurt plastic cups.	8.13	27.559	.270	.443	.724
5.3 - Food containers	7.27	21.393	.678	.641	.643
5.4 - Plastic bottles.	7.73	24.457	.432	.374	.698
5.5 - Drinking straws.	8.58	28.589	.430	.292	.711
5.6 - Beer bottles.	7.85	29.574	-.008	.183	.789
5.7 - Rotten food.	7.73	25.053	.525	.672	.683
5.8 - Fruit.	7.81	24.028	.497	.657	.685
5.9 - Over-prepared food.	8.29	25.530	.559	.463	.682

Source: Mota, 2013.

For qualitative analysis, the subsample represents 61.02% of the total number of divers, and just for the record, 38.98% of participants (92 divers) did not want to participate in the qualitative study (see Table 4.28).

Table 4.28: Amount of web surveys sent for the qualitative study of the long-term impact from diving activity.

Follow up for the online survey.			
		Frequency	Percent
Valid	Yes, I have sent the follow-up survey	**144**	**61.02**
	Didn't want to participate in the last phase of the study	92	**38.98**
	Total	**236**	100.00

Source: Mota, 2003.

The study is no longer quantitative, but is still representative for divers visiting Cozumel Island, playing particular attention to possible behavioural changes among student divers. As a consequence, web surveys were sent to all divers who registered to receive the private email with the respective follow-up. Being students or certified divers, both groups populated a list of 144 personal email addresses for the study of the long-term impact caused by diving activity on Cozumel. In Table 4.29, the timeframe illustrates the last phase of the study, being the first email sent on 10th April 2013, citing the first response on the same day, initiating a count of 70 (48.61%) surveys received by 16th July 2013.

Table 4.29: Web surveys sent and received for qualitative analysis.

Statistics

		Date for sending the web survey.	Follow up for online survey.	Date when the survey was sent.	Date when the survey was returned.
N	Valid	236	236	**144**	**70**
	Missing	0	0	92	166
Minimum		05-APR-2013	1	**10-APR-2013**	**10-APR-2013**
Maximum		07-JUN-2013	2	18-JUN-2013	**16-JUL-2013**

Source: Mota, 2013.

Two months after the experience on Cozumel Island, the invitation to participate in the long-term study was emailed to them, and after two weeks without response, a second email was sent with a reminder to fill out the 5-minute web survey. Also some emails could not be delivered due to misspellings, or misreading the participant's handwriting. Table 4.30 gives a breakdown of the 70 web surveys received for analysis, composed 57.15% by certified divers, and 42.85% by diving students.

Table 4.30: Break of participants in the long-term impact survey.

Participants in the web survey				
		Frequency	Percent	Valid Percent
Valid	U.S. Diver	29	12.29	**41.43**
	Non-U.S. Diver	11	4.66	**15.72**
	U.S. Student	18	7.63	**25.71**
	Non-U.S. Student	12	5.08	**17.14**
	Total	**70**	29.66	100.00
Missing System		166	70.34	
Total		236	100.00	

Source: Mota, 2013.

Based on the 70 web surveys received, observations were compared with the previous form administered at the beginning of the study, survey 1. From cluster analysis, it is clear that scuba diving activity does not form good clusters, and therefore is not a good predictor for behaviour; however, comparisons were pictured for visualizing possible differences between groups, and in particular if there is any noticeable behavioural change since participants experienced scuba diving on Cozumel. Table 4.31 (see Appendix M) is not conclusive for behavioural change as it provides overall scores for behaviour rated to the Likert-type scale used. The standard deviation shows some indicative differences, but they are not conclusive. At this level, differences might occur due to better accuracy in the answers, reflecting the normal routine and fresh memory for participating in the study.

For more detailed information regarding eventual changes in the household, Figure 4.48 compares the observations registered by the participants in both phases. Regarding statement 4.1, divers registered improvements in their conduct in the household, with the exception of always performing the behaviour where the tendency was inverted.

Diving students also registered improvements in their behaviour regarding statement 4.1, except for ratings 2 and 3 where they decreased the intensity of their behaviour, but increased in doing it always.

Overall, divers and students registered some level of behavioural change for buying things produced with as little packaging as possible.

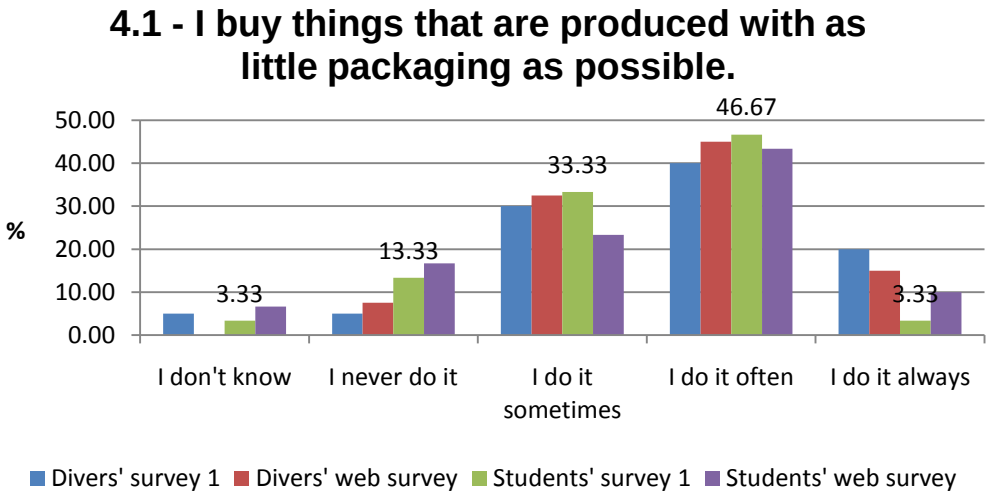


Figure 4.48: Crossing data from the observations registered in survey 1 and the web survey for statement 4.1 (Mota, 2013).

Figure 4.49 shows a small decrease in behaviour, starting with the level of participants who do not know what they actually do regarding using their own bag for shopping rather than one provided by the shop. Certified divers registered a substantial increase in their behaviour for doing it often. Meanwhile, student divers increased in the lower ranks of the scale, but often increased their behaviour.

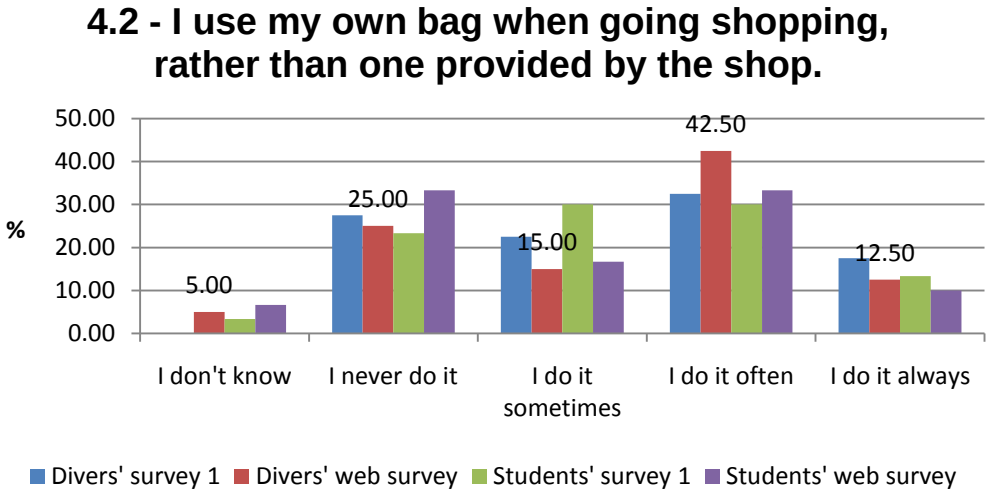


Figure 4.49: Crossing data from the observations registered in survey 1 and the web survey for statement 4.2 (Mota, 2013).

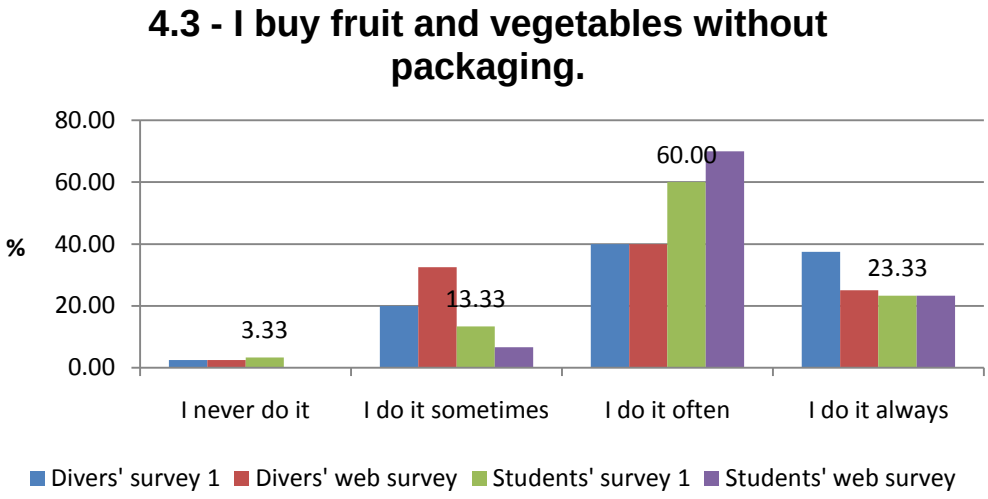


Figure 4.50: Crossing data from the observations registered in survey 1 and the web survey for statement 4.3 (Mota, 2013).

Figure 4.50 shows stability for certified divers in regards to never doing it and often, although doing it sometimes and always shows inverted behaviour for buying fruit and vegetables without packaging. Student divers increased their level of behaviour, performing much more often for the same statement.

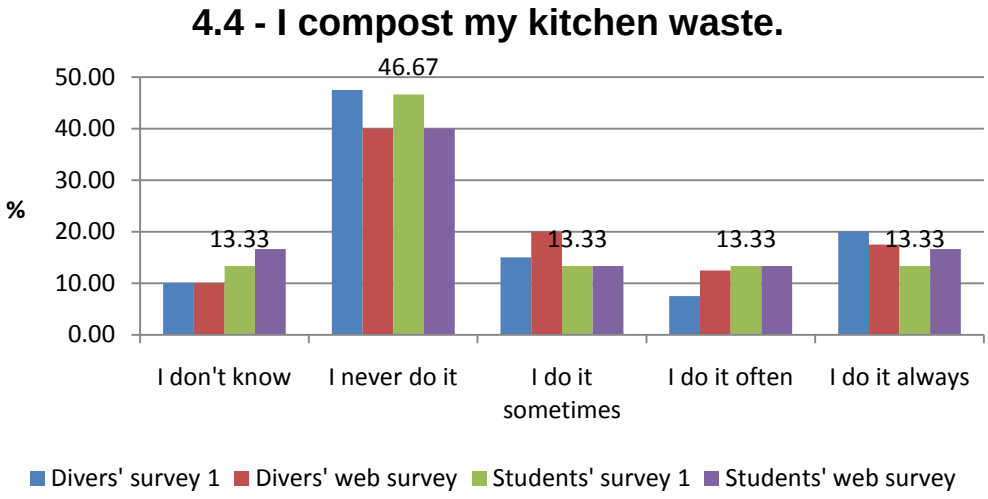


Figure 4.51: Crossing data from the observations registered in survey 1 and the web survey for statement 4.4 (Mota, 2013).

Figure 4.51 is quite even among divers and students, registering high peaks for both groups for never composting their kitchen waste, although a considerable percentage of divers still do not know the meaning of composting.

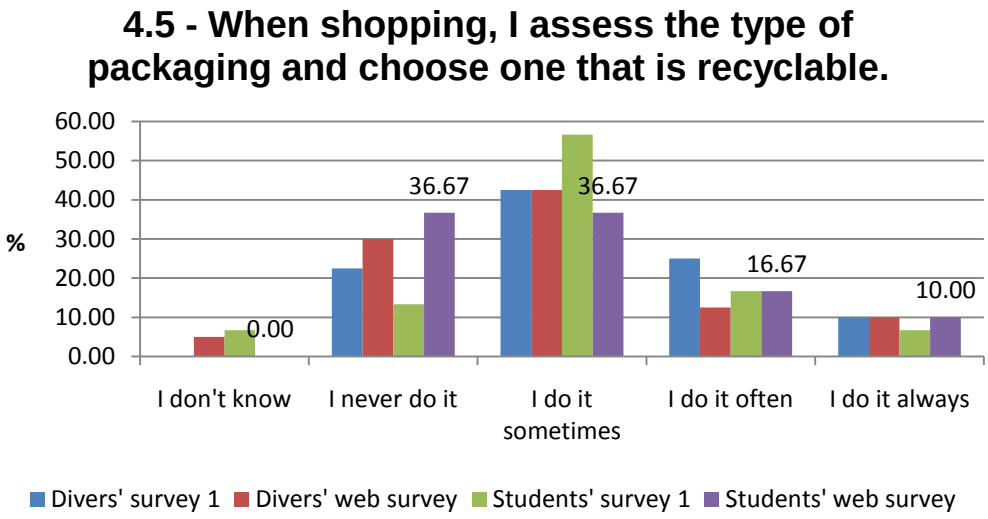


Figure 4.52: Crossing data from the observations registered in survey 1 and the web survey for statement 4.5 (Mota, 2013).

Figure 4.52 represent changes in the diver's behaviour, increasing the lower ratings for never doing it, or even do not know. When shopping, there is a solid tendency to sometimes and always assessing the type of packaging and choosing one that is recyclable, but decreasing in often performing the behaviour. Diving students highly increased the level of not doing it, probably as a consequence of reducing the higher ranks of the scale, adjusting their observations to their routine life.

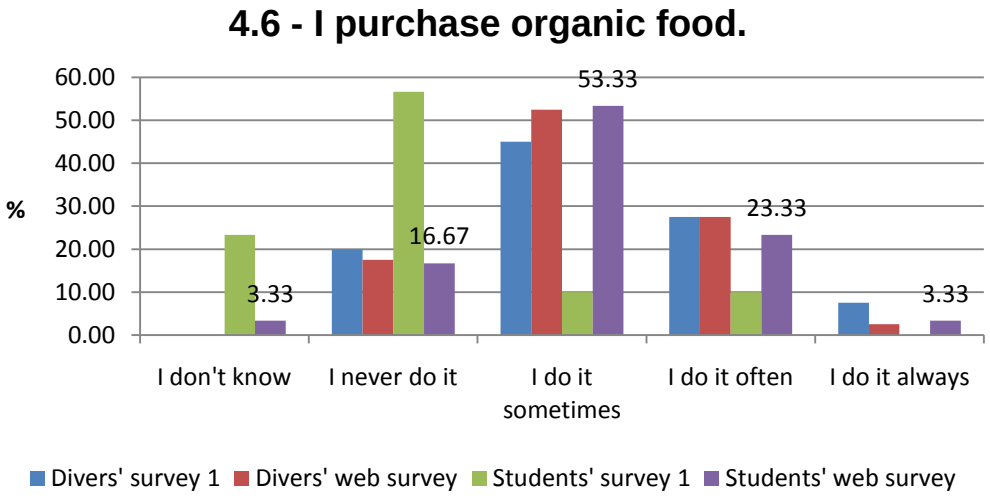


Figure 4.53: Crossing data from the observations registered in survey 1 and the web survey for statement 4.6 (Mota, 2013).

Figure 4.53 is consistent among certified divers, showing small dissimilarities, although student divers overrepresented their observations during fieldwork, reducing drastically from never purchasing organic food, while surveyed on Cozumel, to high levels of performance sometimes and often purchasing organic food.

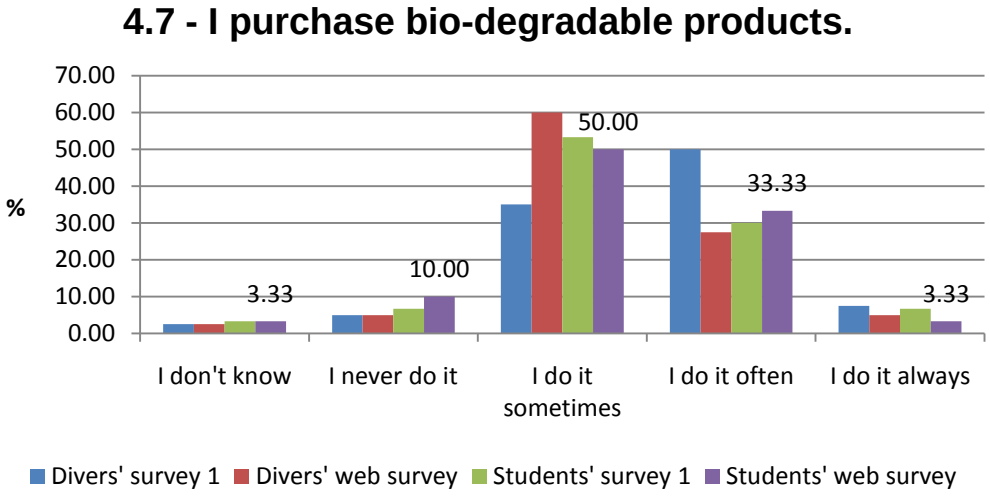


Figure 4.54: Crossing data from the observations registered in survey 1 and the web survey for statement 4.7 (Mota, 2013).

Figure 4.54 refers to purchasing bio-degradable products, having divers in general performing the behaviour sometimes or often. Certified divers decreased from often to sometimes purchasing bio-degradable products, while students showed a tendency to increase their level of performance, and also being well situated between sometimes and often purchasing bio-degradable products.

Looking for ways to reuse things is illustrated in Figure 4.55, with all divers well represented in the higher ranges of the scale. Certified divers increased on doing it sometimes, and often performing the behaviour, but decreased on always looking for ways to reuse things. Students moved up the scale by decreasing the frequency for sometimes, and instead increased the next higher rank, often performing the behaviour.

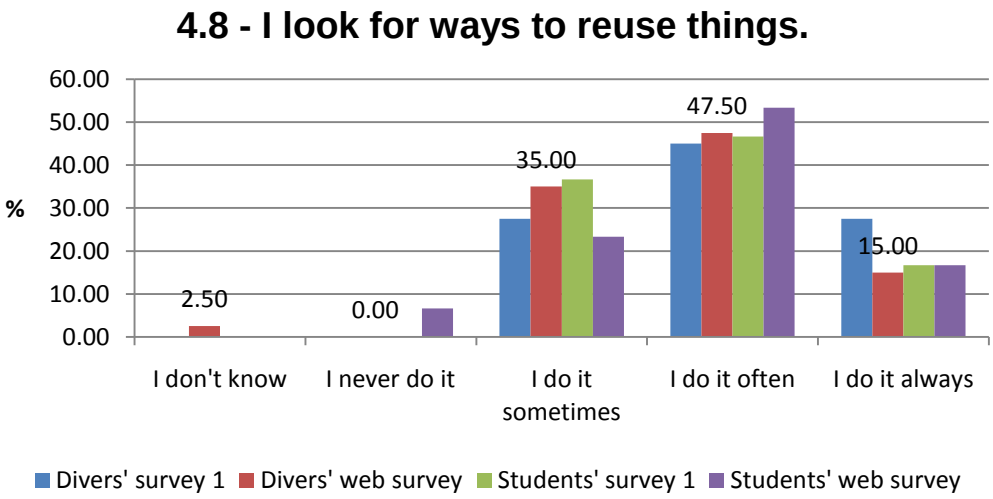


Figure 4.55: Crossing data from the observations registered in survey 1 and the web survey for statement 4.8 (Mota, 2013).

Figure 4.56 is a perfect picture of the solid waste management implemented in the field. That is to say, both groups are very active on the system, separating materials like newspaper, cans or bottles for recycling. Participants registered most of their behaviours on the higher ranges of the scale, often and always performing the behaviour.

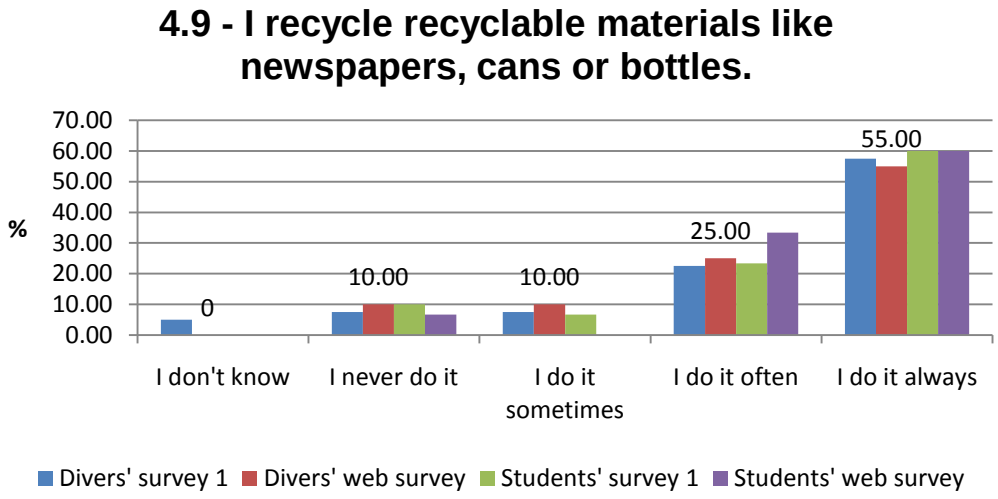


Figure 4.56: Crossing data from the observations registered in survey 1 and the web survey for statement 4.9 (Mota, 2013).

Although there are some participants who never perform the behaviour or do it only sometimes, this could be due to an inefficiency of the separation and collection system, or even that they are not motivated to perform the behaviour.

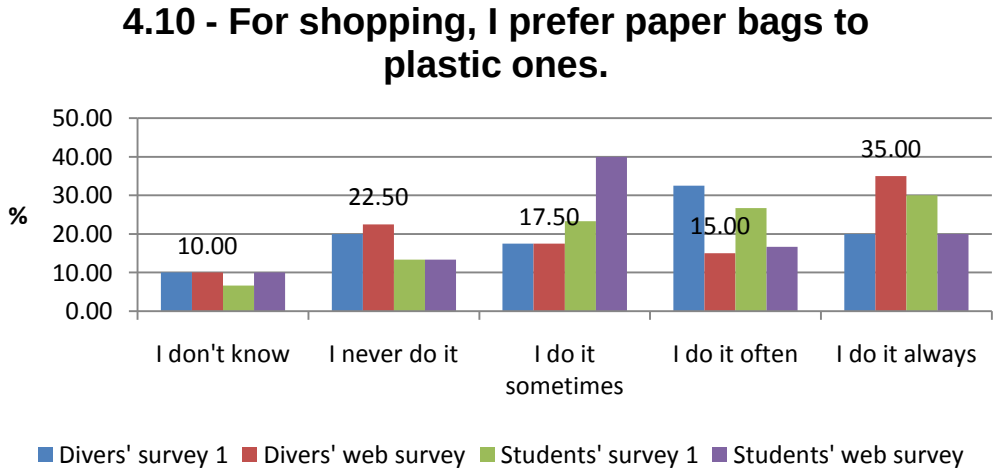


Figure 4.57: Crossing data from the observations registered in survey 1 and the web survey for statement 4.10 (Mota, 2013).

For shopping, Figure 4.57 shows consistency for certified divers at lower ranks of the scale, and an increase in their behaviour towards always preferring paper bags to plastic ones. Students are also consistent in their lower ranks of the scale, increasing the level of doing it sometimes, by decreasing the two top levels of the scale.

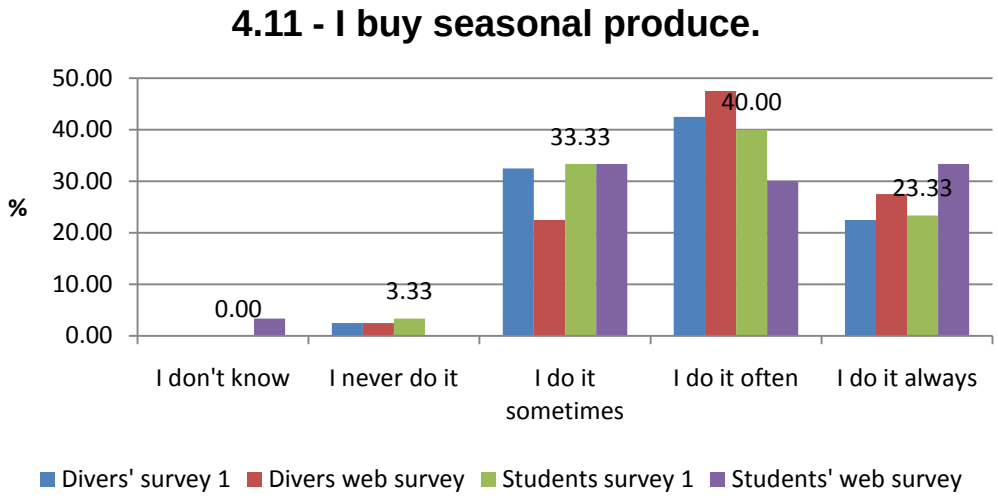


Figure 4.58: Crossing data from the observations registered in survey 1 and the web survey for statement 4.11 (Mota, 2013).

Figure 4.58 shows high levels of participation in purchasing seasonal produce. Certified divers increased their behaviour towards always buying seasonal produce, while students stayed equal on sometimes buying season produce, but also increasing their level of activity to always perform the behaviour.

During fieldwork, student divers were assessed for disposal of products that are usually found among marine debris, matching the objective of studying possible influences of scuba diving activity in reducing municipal solid waste at the divers' location. Such an achievement could contribute to the reduction of marine debris. Items were ranked on a scale with natural numbers, representing quantities of items disposed of daily, and also used for the long-term impact registered in the web survey. There is the aspect that while on Cozumel Island, divers were questioned individually, and the long-term impact asks about items discarded in the household. The comparison revealed interesting data regarding

the fact that not all participants are the head of the household and, in a very subjective way, observations still represent individual behaviour.

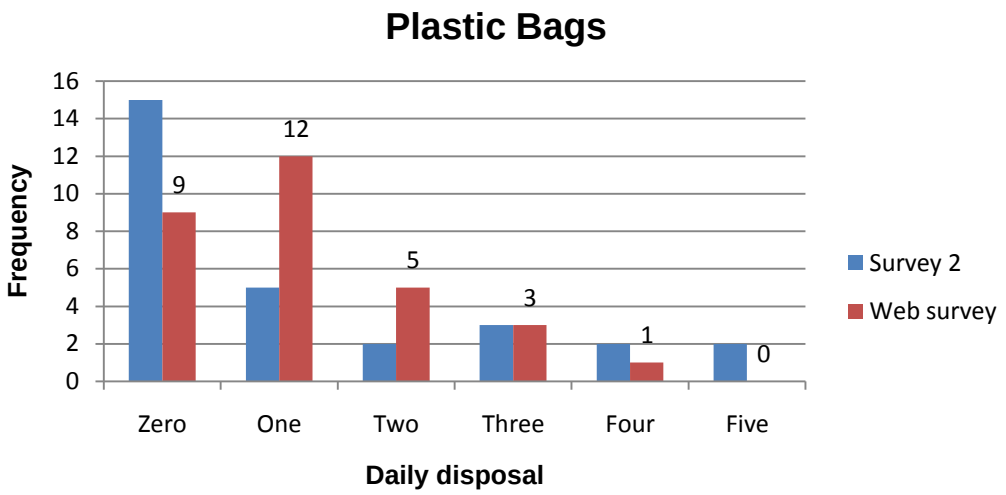


Figure 4.59: Crossing data from the observations registered in survey 2 (for students) and the web survey for plastic bags (Mota, 2013).

Figure 4.59 indicates a considerable level of plastic-bag use during holiday, which in turn increases a great deal in the household, with 1 to 4items being disposed of every day.

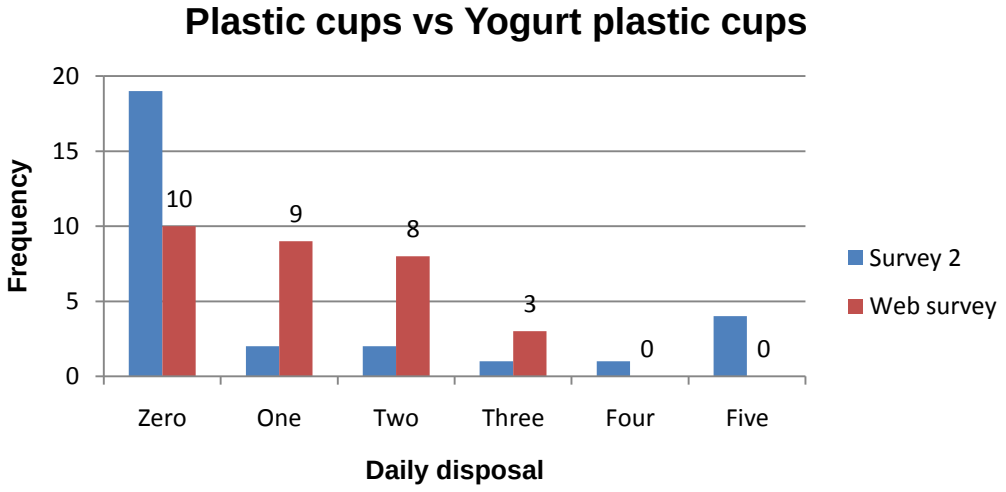


Figure 4.60: Crossing data from the observations registered in survey 2 (for students) and the web survey for plastic cups versus yogurt plastic cups (Mota, 2013).

Figure 4.60 compares the single-use disposable plastic cups on Cozumel Island with the plastic yogurt cups consumed in the household. There are participants who probably do not consume yogurts, but numbers increases drastically from 1 to 3 items disposed of a day in the household.

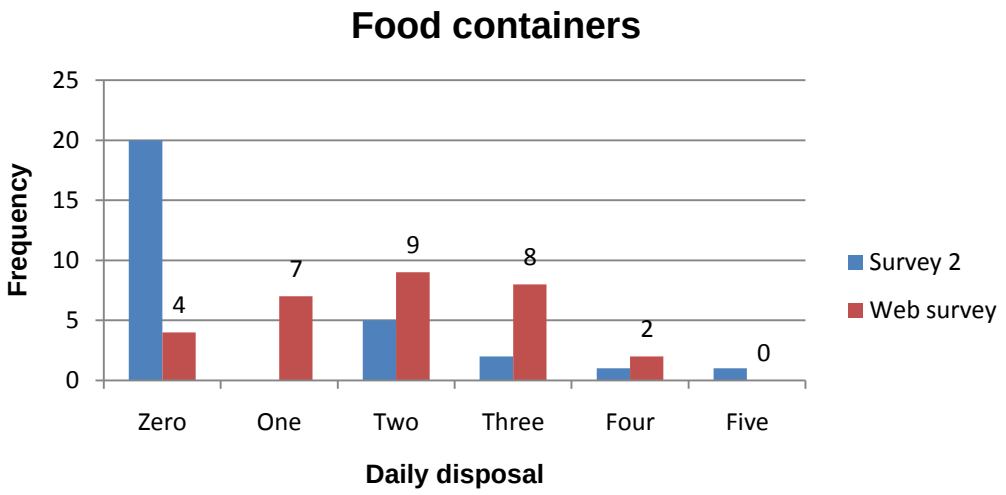


Figure 4.61: Crossing data from the observations registered in survey 2 (for students) and the web survey for food containers (Mota, 2013).

Figure 6.61 compares food containers, which reach their peak for 2 items per day in the divers' household. While on holiday, only some food containers were disposed of due to the fact that many participants were traveling on all-inclusive cruise ships, staying on the island for a single day and not consuming much from food containers. However, in the household, 1 to 4 food containers are disposed of every day.

Figure 4.62 illustrates the high consumption of plastic bottles while on holiday and in the divers' household. Plastic bottles represent fighting dehydration and the need to consume certain beverages. While on holiday, divers consumed quite a lot of plastic bottles, and in comparison to their routine back at home, from 1 to 4 plastic bottles are discarded every day, giving signs of a strong dependency on plastic-bottled beverages.

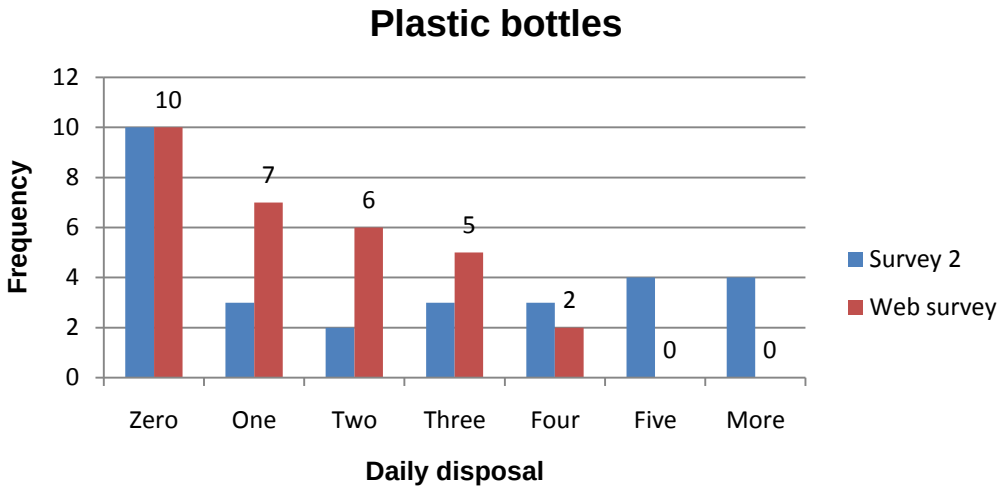


Figure 4.62: Crossing data from the observations registered in survey 2 (for students) and the web survey for plastic bottles (Mota, 2013).

Figure 4.63 highlights the use of a single-use plastic item, called a drinking straw, which is very common to use at tourist destinations and also in the divers' household.

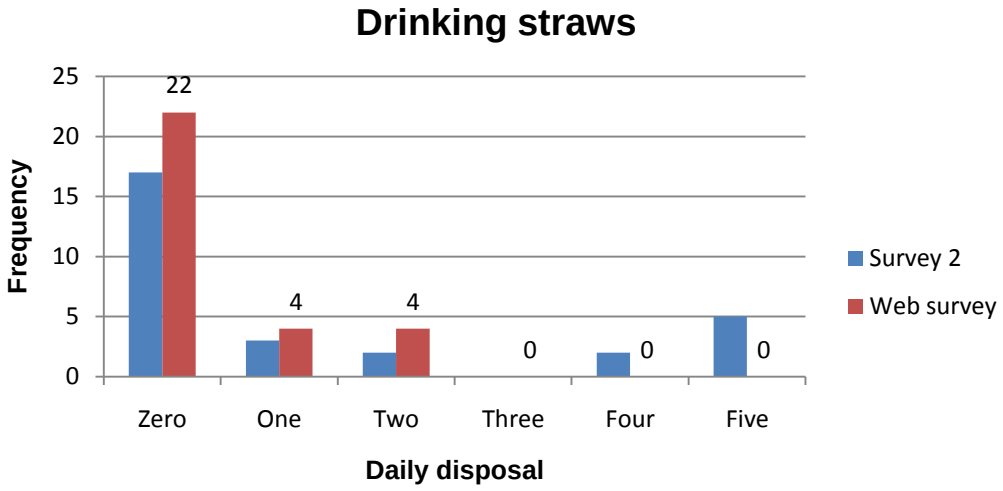


Figure 4.63: Crossing data from the observations registered in survey 2 (for students) and the web survey for drinking straws (Mota, 2013).

Drinking straws are highly represented by not being consumed by the time the survey was administered, but a maximum of 5 straws are disposed of

per day. They are also not consumed that much in the household, but always shows 1 or 2 discards per day.

Figure 4.64 shows no consumption of beer bottles during the holiday, or at least at the time the survey was administered. The curious fact is that survey 2 was administered firstly to diving students during the morning, and already registered some alcohol beverages. Moreover, most of the participants were arriving from all-inclusive cruise ships, and the reflection of that behaviour is that beer makes up part of the divers' daily routine. Observations registered the consumption and discarding of 1 to 4 beer bottles per day, with the peak discard of1 bottle in the household.

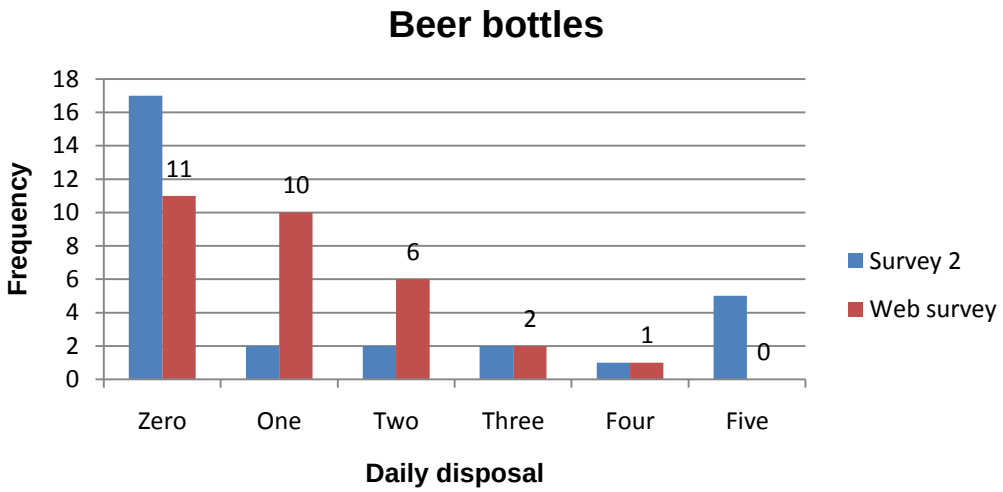


Figure 4.64: Crossing data from the observations registered in survey 2 (for students) and the web survey for beer bottles (Mota, 2013).

Figure 4.65 gives an overall representation of the daily discards of food items in the divers' household. With all inputs received during the holiday and the environmental education session, food still reaching high discard levels. From 1 to 3 items of fruit, rotten food, or over-prepared food are discarded daily, with1 or 2 items of rotten food, and fruit more frequently discarded daily. At least 1 piece of fruit is discarded every day, rotten food and over-prepared food is a reflex of the practices and habits for consumption in the household. The type of measured food fit together, and are disposed of up to 3 items, suggesting some practices changing in the household.

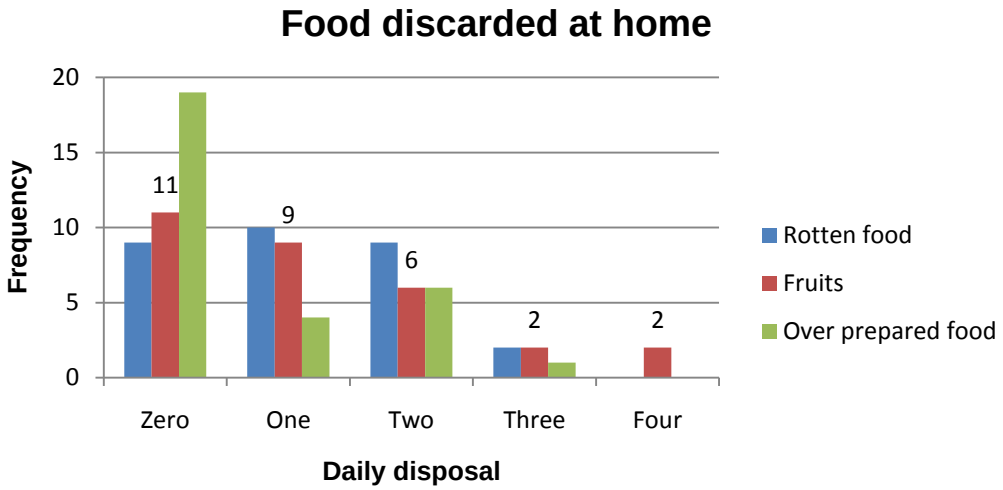


Figure 4.65: Observations registered in the web survey for food discards at home (Mota, 2013).

Divers participating in the web survey are characterized by being interested in contributing to academic studies, and research on scuba diving, in particular behaviours related to environmental practices and marine debris. Also certified divers (57.15%) demonstrated being more perceptive of marine debris affecting the water environment, and therefore more interested in participating. Diving students were particularly targeted for studying long-term impacts due to not being as aware of the underwater world as certified divers. At this level, scuba diving demonstrated a potential to be an important nature-based activity fostering environmental education.

4.9. The long-term impact measured for the household behaviour variable – BEH

From the total of 70 surveys received, the variable AWARE was understood as a very important variable to insert in the model, as it motivates people to talk about environmental aspects and makes them feel satisfied about enjoying nature-based activities such as scuba diving.

“We shared our memories of the beautiful animal life in the ocean surrounding Cozumel” (Participant in the study, 2013).

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In the process investigating if scuba diving can affect divers' behaviour in their household, it will be taken into account that 42.86% of the surveys received were from diving students, and 57.15% from certified divers. In the qualitative phase, the variable AWARE is controlled by spreading word about environmental practices and the scuba diving activity, with the hope of influencing people to adopt good environmental practices.

The following question provides some good feedback from participants:

1 - Since you have returned from your diving on Cozumel, did you share your experience with anyone?

(Web survey in Mota, 2013)

- Yes I Did, It Was One Of The Best ExperienceS Of My Life.
- Yes. We discussed the dive and aquatic sea life.
- Yes. With fellow divers and those interested in diving.
- Certainly, I told all my friends about the scuba lessons, as well as the beauty of Cozumel
- For sure I did, it was a great experience, perhaps the best of my life.
- I told many people about the beautiful and awesome diving on Cozumel.
- The quality of the sites.
- Yes I have! With all my family and friends! Told them how that experience was the best and that they should engage in activities just as the one I experienced!
- Yes, friends and family members.
- Yes, I shared it with many people.
- Yes, mainly how wonderful the underwater world is.
- Yes, shared details of my dives and the company I dove with.
- Yes, shared pictures and stories with a few friends.
- Yes, showed them pictures and video.
- Yes, we highly recommended the experience to our friends.
- Yes. How fun it was to dive and what it was like.

In the long-term impact analysis, behaviour was controlled by several observations from previous surveys; among certified divers answers were tested

for the consistency of comments written for question 3.3 from survey 1. Divers reported a broad awareness regarding attitudes to consuming certain goods, and increased their awareness of the impacts created by humans in the general environment. Divers reported a reduction of plastic, and some level of change in practices for waste management in their household.

Probably the most reported behaviour was separating garbage for recycling, and changes in food habits such as consuming less fish, or not purchasing fish from markets and only from specific fish shops. Also environmental awareness was reported to have increased regarding impacts on the marine environment and resource consumption. Altogether this creates a general profile of certified divers, which is expected to match with the long-term behavioural changes.

Appendix J has a list of all observations registered from participants to the following question:

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2 - Since you have taken your very first dive, in what way did you change your behaviour towards the environment in your household?

(Web survey in Mota, 2013)

Some participants reported awareness since the early stages of this research, where “recycling is something that is encouraged by municipal government and reusable shopping bags have been encouraged by stores charging for plastic. We tend to pick up garbage when we are walking our dogs to make our neighbourhood cleaner”. Divers have the opportunity to act because they feel they identified with the issue of cleaning their surrounding area and are somehow responsible for it. Some divers recognised that diving did not their behaviour affect at all, as they always tried to clean up after themselves, take care of the trash and always disposed of garbage in the correct bin. Others already had good environmental practices for recycling products, or were “aware of their decisions and how they affect the environment”.

For some participants, since they started scuba diving, raising awareness has been a continuous process for understanding “how garbage impacts aquatic life, and ruins dive sites”. People started to become more environmentally friendly by changing their behaviour when disposing of, for example, hazardous

materials, and started to understand the “difficulty of removing trash from islands, becoming more conscious about recycling all materials, but especially plastics”.

“I think I have always been environmentally aware, this being able to scuba and see the beauty underwater just reinforced the need to be respectful of all nature in all environments” (Participant in the study, 2013).

Also behaviours changed for food habits, such as eating only certified sustainable seafood, by recognised organizations that issue codes of conduct for consumption regarding species, sizes and seasons for catching. An actual issue like protection of endangered fish species, was recorded by one participant who reported “diving has changed my life and I have stopped eating shark”. Indeed scuba diving can influence people’s decision to perform certain behaviours, as through awareness and environmental education, divers can become more conscientious about the kind of food they choose to eat with respect to sustainable seafood. Some radical ways to deal with the issue were reported such as stopping eating fish.

Trips to certain diving destinations, which are on the route of the ocean gyres, showed first-hand how much plastic ends up in the ocean, encouraging behavioural changes in reducing, reusing and recycling as much plastic as they can. Divers became more interested in stories about environmental protection, sea environments and sea creatures; informal conversations tended to lead to the subject of awareness of the trade in fish when they go for shopping and, very importantly, people are aware that recycling is not enough, as it can be an excuse to care less about excess packaging.

Along the same lines, participants reported an awareness of rain runoff, which sweeps away all debris into water bodies, contaminating the environment, in particular with plastics.

Crossing data with the observations registered for variables HATB and PBC from survey 1, divers responded to the long-term survey by registering the type of products usually recycled in their household. The selection of products strongly depends from the local program/system for absorbing the selected discards, which are also dependent on the technology used for handling materials. Moreover, for public health and environmental reasons, there is the

social responsibility to remove municipal solid waste, and from the consumer side it is very important to participate in such practices. An additional incentive resides in the fact that waste still represents an economic value, especially waste that can be reused or recycled.

Not being a comparison between the different recycling systems in the U.S., the question shown below aims at gaining an understanding about how divers can be sensitive to the issue, and verify what materials they perceive can be recycled.

3 – What type of materials do you recycle?

(Web survey in Mota, 2013)

Some participants clearly reported a very passive attitude by not sending any material for recycling and stating it was “not worth the time and petrol, whereas others drive long distances to dispose of their garbage at the local curbside recycling station. When talking about recycling products, one must think in organizing adequate room, especially when living in small residence, or communities where garbage collection takes place over a considerable time distance or frequency. Also, residents do not actually know what system is used locally; in some areas there is a clear and effective waste management program, whereas in some others items are disposed of all together at the same curbside station where the recycling department does not require sorting in the household.

In some cases, separation used to take place out on the streets, but for some reason is no longer in use, with consumers having to dispose of their waste without sorting it. Looking for a sustainable management, information can be the key factor along with environmental education for raising awareness of the impacts and needs for humankind. For example, a diver from Singapore reported “a recycling system where the Government provides you a large plastic bag monthly and you can put in all the items you want to recycle or is recyclable. They will come and collect it at the end/beginning of the month” (Web survey participants in Mota, 2013). Also in Europe, in countries like Germany, specific plastic bags are provided for disposing of certain items that can be recycled.

Responsibility had the effect of some divers not consuming certain types of products, which cannot be reused or recycled, or just because they were not part of their consumer habits. Behaviours for recycling products were registered for almost all participants, who agreed to participate in the long-term impact study. The products listed below represent the majority of those collected for recycling within the U.S. borders, and also the economic value addressed to each item. For example, glass bottles can be reused and is widely collected; aluminium can be transformed for reuse, with the same for paper and cardboard, and any metal that fits the municipal solid waste description.

- Anything recyclable;
- Aluminium;
- Aluminium foil;
- Cardboard;
- Cardboard boxes;
- Cartons;
- Cereal boxes;
- Electronics;
- Food waste;
- Garden waste;
- Glass;
- Glass bottles;
- Kitchen waste;
- Metal cans;
- Newspapers;
- Organic waste;
- Paper,
- PET.
- Plastics;
- Plastic bags;
- Plastic bottles;
- Proper disposition of batteries,
- Plastic water bottles;
- Some composting of food waste;
- Steel;

4.10. The long-term impact measured for PBC in the divers' household

Divers were cross-checked for their perceived behaviour control by referring to products and behaviours already mentioned, showing consistency in their answers when describing their ability to perform the behaviour by controlling their routine. The majority of participants stated they look for recycling

products like paper, glass, aluminium cans and plastic containers, while others look to recycle everything they can, but not hinging their shopping on whether the goods are recyclable or not. When showing greater responsibility and commitment, divers might purchase goods by looking for the recycling symbol on the item, whereas others do not directly look for recycling products, but ultimately most of the packaging they might purchase tends to be recyclable or at least reusable.

The goodwill for a conscientious purchase takes around 50% of the surveyed divers to contribute to minimizing their ecological footprint by looking for recyclable products in their daily routine. However, participating in recycling programs does not necessarily mean that all divers are continuously looking for recyclable products and basing their choices and behaviour on recyclable items. Divers also live in asocial community, suggesting rules and providing a whole system for waste management, which expects a certain behaviour from the consumer side. It would not be wrong to say that technology plays an important role when deciding what products society should separate, which also influences purchases.

The key question from this research lies on the registry of the eventual behaviour change that occurred after participants had arrived home from Cozumel Island, in particular diving students. The cross-check from the variable PBC, from survey 2, was conclusive for verifying if scuba diving can influence new divers in their household for good practices regarding plastic and food disposal.

Question 7 from the web survey provided feedback from the diving students:

7 - Since you returned from Cozumel Island, have you changed any behaviour in your household?

(Web survey in Mota, 2013)

Among all diving students, behaviour changes tend to be quite relevant, leading participants to adopt new strategies for reducing municipal solid waste. Divers reported starting using a shopping list, minimizing the purchase of unnecessary products for the house and contributing to better organization in the storeroom and refrigerator. Also divers started looking for products with less

packaging, meaning fewer discards for the curbside bin, and greater cost-efficiency impact for the whole waste management system.

Garbage separation was also enforced by divers as one of the most common changes in their household, caring about disposing of their waste properly and supporting the reuse and recycling of materials. The fact that participants attended the informal environmental education session, followed by scuba diving activity, encouraged them to be more active in their local system for waste management. Awareness was raised, becoming decisive for changing eating habits, and leading to informal conversations about the impact of tourism on the world.

The percentage of students who did not register any behaviour change did, however, highlight the fact that they tried to reduce the purchase of unnecessary products by using a shopping list, separated garbage in their houses, brought products with less packaging into the household more often, and also looked for recyclable products.

From the whole sample, and selecting only certified divers participating in the long-term impact study, 38.78% stated that scuba diving influenced their decision for behavioural changes in their household. Recording the observations from question 7, it is evident that practices did not change that much, with divers continuing to use the same practices in their homes, with some participants thinking of the ocean as a reusable, renewable resource. However, some remarkable changes did occur, such as using kitchen scraps for the compost heap and purchasing goods with less packaging. Divers reported that since returning from Cozumel Island they also looked for recyclable goods more often.

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4.11. Discussion

Studying a possible relationship between diving activity and the behaviour performed in the household, was demonstrated as relevant for profiling the diving community. Furthermore, it can offer a different approach for understanding how divers tend to act when living in their comfort zone, and if being exposed with certain frequency to the natural environment actually makes them reduce their ecological footprint. The research was focused on testing environmental practices for plastic use and food discards, and the possible linkage between behaviour performed and scuba diving activity.

Natural habitats are more pristine and authentic for visitors' experience at tourist destinations; while taking advantage of such attributes visitors can be educated about the importance of preserving natural resources. Through environmental sessions, the message can be passed through, contributing to the visitor's environmental awareness and future behavioural change.

At tourist destinations, impacts are created by visitors, who have the need to consume certain resources that offer comfort and cover the needs of the tourism setup. Regarding the amount of waste generated by tourism activity, scuba divers and snorkelers tend to be more sensitive to marine debris affecting the marine environment, in particular the conditions at the diving ground. Also, assessing their environmental awareness can raise suggestions for improvements to the destination; this is when it becomes important to study how divers tend to behave in order to provide solutions for handling local waste. Moreover, marine debris can also originate from land activities as it is able to travel large distances, affect marine life and polluting distant destinations.

The title proposed for studying the "synergy between scuba diving and household behaviour: testing plastic and food waste" focuses on a population of divers visiting a well-known diving destination on the Mexican Riviera. For performing the study, natural habitats were used for tourism education taking place at Cozumel Reef National Park. This variable was introduced in the model developed for enhancing visitors' environmental awareness and studying the long-term impact of a scuba diving activity.

From the 236 participants in the study, 76.69% arrived from the U.S. and were made the target for realizing the quantitative study and the object of the literature review. Such a sample size was sufficient for testing the hypothesis

proposed in Chapter 1, verifying correlations between the variables used, and using the Ajzen's (1985) model for explaining the theory of planned behaviour.

The assessment is based on the 720 kg of municipal solid waste produced per capita in the U.S. (OECD, 2013), aiming to study divers' behaviour and educating new diving students about better practices regarding waste management. Also the consumption of food in the U.S., documented for 2010, registered 31% of losses from all food available for consumption in the country (Gunders, 2012). Due to the majority of losses happening at the end of the food supply chain, participants were measured regarding their attitudes and behaviour for reducing food discards.

Participants in the study were assessed while on Cozumel Island, with the majority visiting for only a single day; the destination is a popular stopping point for cruise ships, which drop tourists off on the island for 7 to 11 hours each day. Ships arrive every day except Sunday, contributing to the development of the local economy, sustaining employment, and offering the opportunity to develop a whole industry of services for visitors.

Over approximately 2 months, fieldwork was conducted using the measurement tool used for recording divers' observations and collecting information considered relevant for explaining the obtained results. The invitation to participate in the environmental education course for diving professionals and tourism operators, was decisive in explaining the variable for awareness used in the developed model. From the session, it was possible to verify the level of interactions existent between customers and tourism providers, supporting the need to include the variable AWARE, which proved a direct relation between diving activity and behaviour in the household.

Testing divers required an efficient measurement tool, which was demonstrated to be very successful due to the short time required for registering precise observations. Sometimes divers were not willing to spend much time providing data, but when confronted with the size and design of the survey, they were usually persuaded to collaborate.

The U.S. divers in the study followed the trend from previous profiles, described by different authors like Cater (2001) and Garrod and Grőssling (2008), as those who are highly trained in scuba diving, and those who are completely untrained, called try divers. Moreover, the diving training agency most represented was PADI, followed by SSI and NAUI, confirming the

leadership in the market of the most popular training agency. Also experienced divers were registered with a maximum of 3000 logged dives, but with a median number of 40 dives, and the most novice one having only 4 dives. This clearly does not match the profile provided by Vianna et al. (2010), in which divers had a minimum of 50 dives and 57% had at least 100 logged dives, but the maximum number of dives was not mentioned. Cozumel Island is one of the most popular destinations for coral-reef and drift diving, and is visited by many novices and also very experienced divers. Perhaps the difference resides in the economic availability of visiting Palau as a remote destination, the type of diving suitable for experienced divers, and choosing the destination based on specific attributes that Palau can offer. Cozumel Island is a very popular destination for water-related activities, catering to all ages and levels of expertise.

The diving levels represented in the sample of 99 certified divers, can bring update the description provided by Mundet and Ribeira (2001), Contrel and Meisel's (2004), Musa et al. (2006), Garrod and Grőssling (2008), and Belknap (2008), with a variety of levels for novice or entry-level divers with 1.01% of SD and 63% of OWD; advanced divers were comprised by 16.16% of AOWD and 12.12% of rescue; while professionals were represented by 5.05% of DM, 1.01% of instructors and 1.01% MSDT. For representing diving students, 100 participants were sampled, from which 70% were participating as non-divers in the discover scuba diving program (try dive), 2% were taking the basic entry-level SD, 10% the most common entry-level OWD course, 11% the AOWD, 2% specialty courses, and 1% were being trained for the first level of the PADI professional ladder, divemaster.

41% of diving students registered having previous experience in scuba diving, even among non-certified divers, and 59% had never tried it before. It must be noted that divers with150 dives logged keep upgrading themselves by using specialty dives as continuing education courses.

For describing the divers' demographic profile, Cozumel offered divers of 17 different nationalities, with the majority from the U.S, but worldwide nationalities were well represented in the island's diving scene. As mentioned before, the target population was U.S. divers, as collecting small samples from different nationalities would not hold statistical representative values for further analysis.

In previous studies divers' ages ranged from 31 to 45 years (Mundet & Ribera, 2001), 38 to 53 years (Dema, 2006), 18 to 65 years (Belknap, 2008), and in Vianna et al. (2010) most divers were aged31 to 50, of which22% were over 50. On Cozumel Island, certified divers were 18 to 71 years old, with a modal age of 56 years and diving students aged from 18 to 63 years, with a modal age of 22 years. The profile on Cozumel matches much closer to Belknap's (2008) work, which registered a wider range of divers.

The gender representation on Cozumel was 61.33% male and almost 40% female, confirming previous profiles presented by different authors. Scuba diving is a popular activity, but requires a certain degree of economic affluence; for Cozumel analysis, prices for recreational diving can reach up to 150 USD for a two-tank dive including equipment rental, and try dives can cost up to 115 USD. Participants in the study registered an estimative of their annual household income, with 68% of divers earning more than 45,000 USD, and 12% more than 31,000 USD, representing a figure near the previous references where divers were earning an average minimum of 50,000 USD annual household income (see Table 1.3, section 1.1.2).

Regarding the part of the country from where divers were coming, the majority of 78% were represented as living in inland areas, and around 22% on the coastline. When looking at the data presented in Figure 1.4 (see section 1.1.2) a wide representation can be identified along the coast, but inland areas of the U.S. are much more populated. The study revealed divers as being distributed quite evenly among rural areas, urban areas and cities, with only 5.52% living in highly populated cities.

Divers arriving on Cozumel have several reasons for their trip, compared to Vianna et al. (2010) which reported that 75% were interested in traveling to Palau for shark-diving activities; on Cozumel around 41% were motivated by leisure, and 47.51% to take part in scuba diving and other activities, but always having diving as the main motivation. This is the typical case described by Cater (2001), of "mainliners-sideliners" who are tourists that arrive at a destination motivated by scuba diving, and others for whom the main motivation is tourism but they will also go scuba diving.

Previous profile analysis revealed that divers tend to be quite well educated with the majority holding university degrees (see Table 1.4 in section

1.1.2); on Cozumel, divers maintained this tendency registering 77.35% as having university-level education, including a Ph.D.

The study revealed divers as being associated with environmental organizations, identifying the divers' beliefs, and also conferring some awareness. Such memberships are quite variable and not necessarily related to scuba diving organizations, but with activities or preferences relating to the diver's lifestyle (e.g., National Rifle Association – NRA, Moose Mountain, Pollution prevention). Supporting activities promoted by environmental organizations was expected to be a determinant for forming clusters, but results demonstrated the opposite, with divers clustered in the same group as participants who do not have memberships with environmental organizations.

Questioning divers about problems related to the environment revealed a concern about current issues affecting the environment, and also sustainability. The consumption of natural resources and any kind of waste issue are specific concerns, which have become relevant for their awareness and attitudes towards the environment. This variable demonstrated a high level of importance for forming clusters, and was also an important predictor for behavioural change in the household.

Linking scuba diving activity with behavioural change also became quite important for saying that nature-based activities can definitely be a vehicle for learning and motivating people to rethink their attitudes toward their behaviour. Due to becoming more aware of anthropogenic impacts on nature, people changed their procedures for waste management in the household, and some had been even more radical in changing food habits. Moreover, divers motivated by a good diving experience are more likely to change their behaviour in the long run, contributing to reducing their ecological footprint, thus demonstrating responsibility with their actions.

For some diving students, introductory dives were made from the shoreline, which do not require traveling by boat to the deeper reef; in fact, they were the ones who pointed out marine debris as it tends to accumulate in the near-shore area. Deeper reefs are exposed to stronger currents, which is an important reason for finding the reefs of Cozumel in very good shape and clean. Furthermore, with so many visitors, garbage gets picked up by divers who are more sensitive to the marine debris impacts on marine environments. Overall, diving students understand what benefits coral reef areas can bring to local

communities, such as sustaining employment and generating income (e.g., Dicken & Hosking, 2009; DEMA, 2009; Vianna et al., 2010). However, a significant percentage of divers (48%) are unaware of the role played by the coral barrier, which should alert educational programs to cover this area in more detail in order to help teach good environmental practices. Uzun (2012) already addressed the importance of natural environments for environmental education programs, where participants could learn first-hand about the local environment, stimulating the learning process and raising awareness (Ozaner, 2004; Uzun, 2012).

Having certified divers as a reference for typical divers' behaviour has been demonstrated to be always higher than students' behaviour in regard to the mean value for their attitude toward behaviour (see Table 4.12). However, diving students also demonstrated a good commitment to environmental practices, being differentiated by attitudes for specific items, where the whole sample was at the same level for attitude. For example, when comparing attitudes for composting kitchen waste, both groups demonstrated a low level of activity, but certified divers were noticed to be more active at the top of the scale. Certain practices reflect the type of general waste management system adopted by the local community, where individual participation does not influence the general procedure. Also, buying general produce was recorded with certified divers using the 3 top measurements of the scale, while students used 5. Moreover, when clustering the variables HATB 4.11 and DEMO 6.2 for describing where divers live, the expected rural-area divers always buy season produce, with divers living in cities only doing it sometimes.

Regarding diving students on Cozumel, the time spent on the island dictated the level of consumption of products directly related with municipal solid waste and marine debris. However, plastic bags, food containers, drinking straws, and in particular plastic bottles were consumed with more frequency. The dependency on plastic-related products was evident, reflecting the normal behaviour at tourist destinations, and also standard behaviours in the household.

For studying the long-term impact, all divers participating in the study (n=236) were asked to provide their personal email address so they could receive a private message containing the code for accessing the web survey. 61% of the divers committed to receiving the email, producing a response rate of 30% among all divers, and 49% among divers who volunteered for the long-term

study. Results match Sánchez-Fernández et al. (2012), and Kittleson's (1997) statements for email-survey response rate varying between 25% and 30%. A low response rate was also reported by Falk et al. (2009) of 14.2% in their study on the 9-month long-term impact from visiting a zoo or an aquarium, and also by Bech and Bo Kristensen (2009) when only 17% of participants responded to the web survey in their study conducted in a country where individuals aged 40–59 years (86%) and 60–74 years (57%) could access computers and the internet,.

Such a response rate can be due to the participants' volunteering without the intention to act or not wanting to be bothered by web surveys, which reduced the number of responses by almost 40% (see Table 4.28). Other factors could be a lack of internet access, internet viruses arriving by email, or the amount of spam received leading participants to set filters for undesired emails and invitations for web surveys (Birnholtz, Horn, & Finholt, 2004; Porter & Whitcomb, 2003; Sánchez-Fernández et al., 2012).

The household attitude toward behaviour was adjusted, probably becoming more realistic than the one registered while on holiday. Overall, both groups of divers reflected a more precise behaviour, indicating some changes, which need to be evaluated in conjunction with the remaining variables. Also among students, the amount of items discarded daily was adjusted to a new reality, giving a more precise contribution for daily household waste emissions. With exception the of drinking straws, discarded items increased, and additional items such as rotten food, fruit and over-prepared food registered high levels of daily discards, giving a strong indication of deficient management in the kitchen

Meanwhile the variable AWARE was revealed to be very important, marking the difference in the experience. Participants practiced word of mouth, reporting that they were willing to change behaviours for better waste management in the household. Also some feedback supporting the importance of the variable in the model was registered as follows:

"Ever since I started diving, my sense of responsibility towards the environment has changed. I try to be more responsible and encourage other people to think about our hearth home!"

"I continue to admire the many instances I've seen in which the citizens of Cozumel retrieve and repair discarded appliances, etc. from the streets.

Something that doesn't happen enough in Canada and the U.S., where so many believe these are disposable commodities."

"For me, it's a 'stewardship' issue - I believe that God created us, and gave us the earth to use, but we have an accountability to Him to take care of what we have been given, and pass it on in the same or better shape to our children."

"I personally wish more tourist destinations used fewer plastic bottles and made refilling bottles possible. Guatemala is the only country I've been to where this is easy and practical for tourists."

"I was very impressed with the level of awareness about protecting and preserving the coral reefs in Cozumel. Cozumel is being proactive about protecting the environment because it's good for the environment, and it's good for the local economy because of all the jobs that result from the coral reefs and tourism. Contrast this to vacation places where big hotels and corporations come in and just make money without concern for the environment. Cozumel is doing the right thing!"

"The vacation to Cozumel made me think about ways to protect the ecosystem in my own community. This vacation also made me think about how I can be a more eco-friendly tourist."

"Thank you for making me think these ideas through – we are so busy – we rush, and rush, but Cozumel was a moment to slow down, diving, it was a moment to remember how remarkable the world is. This has stayed with me. I talk about this a lot! Teaching is a good job for influencing the kids."

"Living on Cozumel is a great responsibility, because the environment is very fragile, it is necessary to reduce the maximum production of garbage and be rationed using some things like water."

"Ever since I started diving, my sense of responsibility towards the environment has changed."

“For #7 I can't really say that I began my recycling habits after returning from Cozumel, however being in Cozumel has made me more aware of the quantity of trash that can accumulate from a concentration of people in a small area and it has made me more interested in recycling everything I can in both Cozumel and at home.”

Some other participants praised the study itself, and asked to see the final results having demonstrated an interest in knowing its possible applications. Contributing to such research made participants feel more involved in the process of reducing marine debris, and kept them motivated for behavioural change in regards good waste management practices.

“Good luck in your research! I do hope you will share the results with your survey respondents (-:”

“Continúa con este estudio para tener un planeta mejor y menos contaminado.”

“Good luck with the research.”

“It was nice meeting you on Cozumel. If you are able, will you tell me the results of your study, and any practical applications.”

“Great idea of the survey, please follow up with results.”

“Good luck with your survey. Wish I was in Cozumel now!”

The opportunity to act was given when the environmental session had been delivered during the training program or the specific dive briefing. Some participants felt the need to progress to the next level by taking continuing education courses.

“After taking my open-water course in Cozumel I took the advance open water in Utila.”

Divers feel they identified with the ocean, and were motivated to learn more about marine environments and how to minimize impacts. Even if scuba diving activity is not the blueprint for behavioural change, it definitely plays an important role in conducting awareness, allowing observation of the impacts on the reef. Nature-based activity has the ability to bridge awareness and care for the environment, making people behave more responsibly.

4.12. Recommendations

The study presented is capable of providing a clear understanding of the synergy existent between scuba diving and household waste management practices. Recalling natural habitats for conducting non-formal education programs, scuba divers registered their current practices in regard to plastic and food waste discards. The importance of being involved in the natural environment, is given by triggering the senses of a visitor when engaging in a nature-based activity such as scuba diving. For studying detailed future outcomes, and correlations between scuba divers, and non-divers, the same model can be tested on random tourists visiting Cozumel Island participating in scuba diving, snuba and snorkelling activities. In this way, a new profile can be set, comparing divers and non-divers in terms of their behaviours for waste management in the household. Also the studying behaviours among different nationalities can produce important outcomes for local management, reinforcing Cozumel as a role model for scuba-related sports and environmental education programs on natural habitats.

Scant research on scuba diving has been conducted, with only isolated studies documented for different countries. Without concrete data for active divers worldwide it becomes more difficult to find representative results for describing an accurate divers' profile. From the management point of view, previous studies documented general divers' behaviour regarding scuba diving practices, comfort levels, and divers profile when visiting certain diving grounds. The importance for managing natural resources and tourism activity, required detailed studies about scuba divers and the long-term impacts of such activity. What motivations do divers have? Why do they behave the way they do? What

referential can be chosen? How can the activity be made more sustainable? The argument gains strength by connecting marine debris with land-source waste production, which exists for 'feeding' societies and fulfilling our needs. Moreover, studying divers' behaviour can motivate scientists to extend their targets, by trying to understand the influence of water-related activities, and how much influence they have in the participants' life.

There are good references for a literature review, and representative organizations can also provide good estimates for describing waste production, and how much is recovered annually. Data can be used for economic studies or to back up decisions when targeting a population in the study, or how much a certain material is represented on discards. Although for some countries, numbers can be merely interpreted as orientative values, as they represent part of the real volume of discards.

The measurement tool provided enough information for describing the profile of U.S. divers visiting the reefs of Cozumel. Also through the certified divers, a typical behaviour was estimated for comparison with diving students, especially with those new to the activity. The tool was designed to be short and effective, but a longer set of questions could be used for giving more power to the instrument, registering behaviour and attitudes in other situations related to plastic and food discards. Increasing the set of questions for each variable automatically increases the time needed for registering observations, thus it is recommended to review the sampling procedure for reducing the number of surveys with missing information. When about to go diving, some divers are not interested in spending time filling out forms, so together with the floor manager, sampling times and physical location should be discussed for improvements to the proceedings.

Table 4.26 reveals good fitness for the variables used, although only a few variables were used for forming clusters. As an attempt to increase this number, dichotomous variables can be recoded and evaluated using a Likert-type scale. This is expected to bring more variety to the clusters formed. The use of the minimal number of participants can be associated with the size of the clusters, and as a consequence in some cases it was decisive for rejection; thus it is recommended to use a bigger sample. From the statistical point of view, future analysis should use a bigger sample size, with more than 600 participants from each subpopulation. Also the use of different methods for cluster analysis

can be used for comparison and commenting on possible differences between them.

Furthermore, for explaining significant differences between diving grounds and divers from different nationalities, a new population can be targeted for the use of the model, providing comparative data with Cozumel Island. An interesting study can portray the economic aspects of the diving activity, and the amount of waste generated from such visits to a destination. Tracking discards can also become important for integrating local management tools, and integrating a database of environmental indicators for water-based activities.

Conclusion

The objective of reducing the amount of marine debris in water environments demands studying their origin, composition and methods for raising awareness. Impacts can be measured through sighting unpleasant and menacing pollution drifting in the water, beaching along the shoreline, and in particular through animals affected by marine debris (e.g., Lee et al., 2006; WSPA, 2012). Not as visible but also very important are the altered dimensions of the particles encountered among such types of pollution. Small sizes have become a big concern as they can adsorb chemicals, causing biological contamination when ingested by animals, becoming bioaccumulative along the food chain (Browne et al., 2008; Martins & Sobral, 2011).

The title proposed suggests studying the synergy created between scuba diving and behaviour in the household, trying to answer some questions like differences in behaviour for managing solid waste or how much scuba diving can influence environmental practices. For conducting such research, the group of 181 U.S. divers contributed with representative statistics, profiling divers on Cozumel Island, and testing behaviours in the household regarding plastic and food waste. Furthermore, the use of natural environments, such as the sea, was the stage for delivering non-formal environmental education programs to tourists, raising awareness, and encouraging participants for carry out effective pro-environmental behaviour.

The study was able to find a solution for the first objective, acknowledging that divers can commit to reducing their footprint by adopting good environmental practices for their lives, such as participating in voluntary clean-up actions or independently picking up garbage while walking outdoors. For some people, cleaning up after themselves is a regular practice, but not directly related with being a diver. There is an overall environmental conscious, derived from personal interest and through visiting different locations where waste management practices are also different. Observing wild animals in their natural habitat makes people more aware of the impacts created by human activities, and how sensitive creatures are to them. However, for some divers being conscious of their decisions and how they affect the environment is enough, and they choose not to change their behaviour.

Conclusion

Divers were profiled regarding their behaviour in “consuming plastic, and also food discards”, from which the standard behaviour could be addressed to certified divers. Such a reference was used for comparison with non-divers, and therefore to detect possible differences between the two groups in the study. Certified divers always registered higher-scaled behaviour when compared to non-divers, which is enough to affirm a clear difference in behaviour. The more an attitude toward behaviour scores a higher rating on a positive scale, the more likely it can be used as predictor for reducing plastic and food waste. Also certified divers have a greater tendency to become affiliated with environmental organizations; however, it is not conclusive to sustain differences between certified divers and non-divers. Moreover, such fact does not affect results, and predictions for positive environmental behaviour. Both groups in the study revealed an awareness of current environmental problems, demonstrating concern and interest in talking with friends about problems related to the environment.

In response to the second objective suggested, the study provides strong indications that divers have acceptable or good practices for managing their waste in the household, such as looking for products with as little packaging as possible, buying fruit and vegetables without packaging, looking for ways to reuse things, participating actively in recycling programs, and purchasing seasonal produce. Both groups revealed positive attitudes for reducing plastic and food discards, and that they could perceive whether the behaviour could be performed, and how and when it could be accomplished.

Scuba diving is one of the nature-based activities permitting close encounters with wildlife in a water environment. Such activity is in demand, and since 1992 more than half a million certifications have been issued annually (PADI, 2013a). Cozumel represents a clear response to the third objective of the study, with diving representing more than 45% of tourism motivation for visiting the island, and sustaining the need for the existent environmental education course as part of the indicator proposed by Frausto and Chale (2003). Offering a chance to scuba diving activity to be developed, offers a chance to a multitude of businesses to be established, creating employment and increasing a nation’s gross domestic product (GDP). Natural resources have an additional reason for being well managed, granting conservation and benefits to the island. Furthermore, the preservation of the reef is directly related with coastal zone

management and development, thus divers on the reef can be more effective at detecting impacts affecting the ecosystem.

From the data collected, it is clear that over two thirds of certified divers do not recognize their behaviour as being influenced by scuba diving activity; however, it was acknowledged as making people more aware of marine debris and the issues related to environmental problems. The synergy between scuba diving and household behaviour was also studied through the long-term impact caused on 30% of total participants, in particular the diving students (42.86% of respondents). Such a percentage is comparable to previous studies using long-term impact considerations (Kittleson, 1997; Bech & Kristensen, 2009; Falk et al., 2009; Sanchez-Fernández et al., 2012), and is enough to provide sufficient arguments for accepting the hypothesis:

"H_0: Nature-based tourism, like scuba diving activity, positively affects personal behaviour towards the environment regarding plastic and food waste in the household."

First it must be noted that statistics are purely qualitative, providing indicative values to affirm that awareness, attitude toward behaviour, and perceived behaviour control used in the model have a high predictor value. Together with diving experience and socio-demographic variables, all make a contribution to making people change their behaviour in the household. The long-term survey solicited observations from divers when they engaged in the activity, and then 4 to 6 months after experiencing scuba on Cozumel. Variables such as environmental awareness and attitudes toward the behaviour are decisive for sustaining the hypothesis, where scuba diving is the nature-based activity used as a vehicle to boost environmental awareness, and educate people about marine ecosystems.

When comparing behaviour from pre- and post-experience, differences are not prominent, but when screening by product, facts are highlighted for some level of behavioural change. Also, it must be assumed that while on holiday, participants could just answer randomly without paying much attention, but in the long-term survey, they were committed to providing feedback, and therefore more precise behaviour.

Conclusion

Plastic-related products have a high rate of discards in the household, showing the dependency of a population on using such items, in particular food containers and plastic bottles. Also discarding rotten food, fruit, and over-prepared food items is a common practice among diving students, showing evidence of a routine that justifies more attention and a different solution.

Correspondingly, one third of U.S. certified divers recognizing that scuba diving influenced their environmental behaviours in their routine, also counts as a solid argument for accepting the hypothesis as it tallies with the statements provided by diving students in this research. Divers reported improvements in their environmental awareness and as a result new divers were motivated to make some changes in the household. Also, they realized how important it is to protect the ecosystem, and therefore to question, for example, how to be a more eco-friendly tourist or look for ways to recycle things. Visible changes in behaviour can be noted when divers place more importance on using a shopping list, minimizing the purchase of unnecessary products for the house, thus contributing to better organization in the storeroom. Efficiency with garbage separation and active participation in recycling plans were also substantial changes recorded in the household.

Scuba diving is not a predictor of good environmental behaviour, but has demonstrated its potential for being an important nature-based activity fostering environmental education and awareness. Scuba diving is a facilitator directly related with good predictors for waste management practices in the household. The theory of planned behaviour (Ajzen, 1991) forms the base for the proposed model, studying behaviours in the household where attitudes toward the behaviour and environmental awareness are important predictors for environmental practices. Variables describing socio-demographic aspects from participants, revealed they do not as much power as predictors, with the exception of geolocation in the country where divers are living, and annual household income.

Garrod and Grőssling (2008) referred to the lack of research in the field of scuba diving; however, at the moment there is sufficient literature available for introducing scuba diving activities, registering a few impacts on wild animals and local society, how much diving activity can affect the reef, economic value of certain species, marine park fees, and divers' dispersion across the world. Literature must be updated as many studies were carried out before 2010, and

there is no current record of the actual number of divers in the world. Data can be obtained online or upon request from the training agencies, but only reflecting the number of certifications and not providing a reference for how many divers are active today.

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Resumen de la tesis en castellano

Desde la antigüedad, los seres humanos han vivido en estrecha relación con el medio acuático, arriesgando sus vidas para garantizar una actividad económica relevante para la sociedad. Con la invención de la "válvula de regulador a demanda" en 1943 por Jacques Cousteau y Emile Gangan, se abrió un nuevo horizonte en la relación con el mar, favoreciendo las expediciones, el aprendizaje y los descubrimientos de los fondos marinos. Pero también sirvió para que los océanos incorporasen una nueva perspectiva en las actividades de ocio. El buceo ha estado desde entonces creciendo y ganando relevancia entre las personas dedicadas al mar.

Las previsiones de la OMT (2001) hasta el año 2010 auguraban un fuerte crecimiento de la actividad de buceo en lugares remotos e inexplorados, convirtiéndose en una moda. Hay operadores turísticos que empiezan a mostrar interés en participar, proponiendo asociaciones con bases especializadas en buceo. Debido a una mejor y mayor red de vuelos, los administradores locales crean alianzas con los operadores dominantes y más grandes. Los destinos de buceo se han desarrollado hasta el punto de que hoy en día permiten acoger familias con diferentes motivaciones para viajar, ofreciendo productos turísticos y lugares de interés generados para puro entretenimiento. El buceo está creciendo no solo entre familias, sino también entre solteros y parejas.

Las actividades relacionadas con el buceo se han convertido en actividades bastante populares entre las personas que han practicado principalmente el snorkelling (Orams, 1999). Los factores económicos juegan un importante papel en la adquisición del equipo de buceo, lo cual requiere disponibilidad financiera del usuario, mientras que el "snorkelling" requiere menor cantidad de equipo, siendo mucho más ligero para viajar y más económico.

Desde hace 16 años, el líder de la industria del buceo, la PADI (2013a), certifica a más de 750.000 nuevos buceadores cada año. La agencia de entrenamiento ha alcanzado un nivel de estándares que se encuentran representados en más de 180 países, ofreciendo cursos de buceo en más de 26 idiomas.

Debido a esta actividad, se han observado impactos ambientales positivos que representan esencialmente una ganancia económica y oportunidades de empleo. Sin embargo, hay autores que siguen mostrando su preocupación, desvelando el impacto en la vida silvestre, en la cual los animales cambian su comportamiento debido al contacto con los turistas (Forestell y Kaufman, 1990; Orams, 1996; Falk et al., 2007; Ballantyne et al., 2010). El sobreuso de los arrecifes está dando lugar a la devastación física y a la contaminación química que ocurre en la cercanía de zonas costeras, desarrolladas para el apoyo a la actividad. El desarrollo de estructuras relacionadas con la actividad conllevan también impactos negativos, que influyen en los patrones de vida y señalan diferencias económicas entre la sociedad local (Rouphael y Inglis, 1997; Moscardo et al., 2001; Musa, 2003; Garrod y Grossling, 2008).

Los desechos marinos, con origen en el mar, están en su mayoría relacionados con las actividades de la industria pesquera y las estructuras de cultivo de peces, o de cualquier otra instalación en alta mar. Mientras que los desechos producidos en la tierra, alcanzan el mar a través de la escorrentía de aguas de superficie, arroyos, ríos y lagos (Hinojosa y Thiel, 2009). Los impactos se crean a partir de los desechos marinos varados en la costa, afectando fuertemente al ecosistema marino (Coe, 1990; Calgani et al., 1996; Martins y Sobral, 2011; WSPA, 2012).

Los desechos pueden atrapar animales enredados, privándoles de nadar, o afectando a su reproducción (WSPA, 2012). Grupos de científicos han reportado escombros en las principales rutas de navegación, como también siendo transportados por largas distancias. La principal clasificación de Hinojosa y Thiel (2009), cita impactos negativos por desechos marinos en los animales que se refieren al de enredo, ingestión y el transporte de fauna asociada. Sin duda, estos son los principales efectos reportados, ya que los animales se enredan en las redes de pesca, o en los cables que flotan en el agua. Los desechos son confundidos con alimentos para ser ingeridos o para alimentar a sus crias. Los escombros que flotan en el agua dan la oportunidad para que algunas especies puedan viajar, escondiéndose de grandes depredadores o incluso invadiendo los territorios de los que no son nativos.

El reconocimiento del problema ambiental global, ha llevado a trabajos en la legislación para la protección de los mares y del ecosistema. La

convención internacional MARPOL 73/78 ha prohibido el vertido de residuos, de petróleo y la contaminación de escape de las embarcaciones, lo que minimiza la contaminación que en el mar. A pesar de los esfuerzos, todavía no es suficiente para controlar los desechos marinos; trozos de poli estireno expandido salen flotando en ambientes acuáticos, procedentes principalmente de instalaciones de acuicultura, botellas y bolsas de plástico, entre otros (Hinojosa y Thiel, 2009). Los países que se han interesado por el tema, están monitorizando su línea de costa, por ejemplo Ivar do Sul y Costa (2007), Martins y Sobral (2011) han encontrado restos de tamaño reducido varados en la playa, con un contenido considerable de contaminantes orgánicos persistentes (POP en inglés).

Se ha estimado que el gran parche de basura del Pacífico es el mayor del mundo, donde los desechos acumulados son debido a los movimientos de la Tierra y a los “termohalinas” que mezclan corrientes con distinta salinidad y temperatura. Este importante hecho ha llevado a la comunidad internacional a buscar opciones para minimizar la problemática, firmando así la Declaración de la Asociación Global de Soluciones de Basura Marina. Seis proyectos se han desarrollado para educar a la población, para la realización de más investigaciones, trabajar políticas públicas, intercambiar las mejores prácticas, trabajar en programas de recuperación y reciclaje de plástico y, por supuesto, controlar el "proceso de ciclo de vida del plástico".

Este trabajo de investigación está poniendo a prueba la hipótesis de utilizar la sinergia entre el buceo y el fondo del mar como aula de naturaleza para que, a través de sesiones de educación ambiental, los buceadores realicen cambios de conducta para lograr mejores prácticas de gestión de residuos en el hogar. Después de comprobar que la composición principal de los desechos marinos son plásticos, hubo una evaluación de los buzos, en cuanto a prácticas de consumo de productos de plástico y comida descartada, como potenciales desechos marinos.

Con el actual registro de desplazamientos turísticos observados y la creciente demanda por la actividad de buceo, el trabajo de campo estuvo enfocado en acceder a turistas que buscaban un destino bastante popular para la práctica de deportes acuáticos. A todos los turistas estadunidenses que visitaron la isla de Cozumel, durante el periodo de 5 de febrero hasta el 7 de abril de 2013, motivados por la práctica de la actividad de submarinismo, se les hizo una encuesta para conocer su perfil de comportamiento ambiental. La isla

de Cozumel ofrece excelentes condiciones para el buceo de arrecife y también una gran variedad de entretenimiento durante el día. Los turistas llegan a Cozumel sobre todo viajando en barcos de crucero, representando la mayoría de las afluencias a la Isla. Tambien, viajando en ferry los turistas llegan desde el continente, recibiendo las bienvenidas e incitación a acomodarse en uno de los 45 hoteles disponibles (SEDETUR, 2012).

El estudio comprende las variables presentadas en el modelo que se muestra en el capítulo 1 (véase la sección 1.2), y responde a preguntas utilizadas en investigaciones comandadas por varios científicos que estudian cuestiones ambientales relacionadas con comportamientos humanos (Kaiser et al., 2003; Bortoleto et al., 2012; Barreiro-Rodríguez et al., 2012; Miao y Wei, 2013). La variable que estudia "La actitud en el hogar hacia el comportamiento" cuenta con una escala del tipo Likert, donde son registrados comportamientos rutinarios de los participantes.

Haciendo uso del modelo propuesto en el capítulo 1 para comprobar la hipótesis H_0, el estudio busca respuestas a preguntas específicas sobre las prácticas ambientales y el cambio de comportamiento por la práctica del buceo:

1. ¿Cuál es la influencia que tiene la actividad de buceo sobre el cambio de comportamiento ambiental, en relación al uso de plástico y a la cantidad de desechos de comida en el hogar de un buzo?

2. ¿El hecho de tomar un curso de buceo hace que se cambien las prácticas ambientales en el hogar o solamente se manifiesta una consciencia ambiental que tolera las mismas prácticas de antes?

El objetivo de reducir la cantidad de desechos marinos en ambientes acuáticos, exige estudiar su origen, la composición y los métodos adecuados para sensibilizar a la población. Los impactos pueden ser medidos a través de la observación de la contaminación visual, alterando la estética del lugar, y la contaminación amenazadora a la deriva en el agua, varada a lo largo de la costa (Lee et al., 2006; WSPA, 2012). No tan visible, pero también importante, son las dimensiones de las partículas encontradas entre el tipo de investigación de la contaminación. Los tamaños pequeños se han convertido en una gran

preocupación, ya que pueden adsorber productos químicos, provocando una contaminación biológica causada por ingestión, bio-acumulándose a lo largo de la cadena alimentaria (Browne et al., 2008; Martins y Sobral, 2011).

El título propuesto sugiere el estudio de una sinergia creada entre el buceo y el comportamiento en el hogar, tratando de responder a algunas preguntas como las diferencias en el comportamiento de la gestión de residuos sólidos o cuánto puede influir el buceo en las prácticas ambientales. La investigación de un grupo de 181 buzos estadounidenses ha contribuido con estadísticas representativas, dando el perfil de submarinismo en la isla de Cozumel y también pruebas de conducta en el hogar con respecto a los residuos de plástico y alimentarios. Más aún, el uso del ambiente natural, el mar, fue el escenario utilizado para conducir programas de educación ambiental a los turistas, invirtiendo en la sensibilización y el estímulo para un comportamiento pro-ambiental más eficaz.

El estudio ha encontrado una solución para el primer objetivo, reconociendo que los buzos pueden comprometerse a reducir su huella ecológica, adoptando buenas prácticas ambientales en sus vidas, como la participación en acciones voluntarias de limpieza o, de forma independiente, recogiendo basura mientras caminan al aire libre. Para algunas personas limpiar es una práctica normal, pero no está directamente relacionado con el hecho de bucear. Hay una conciencia global del medio ambiente derivada de un interés personal y el hecho de visitar diferentes lugares donde las prácticas de gestión de residuos son muy diferentes de su hogar. El hecho de observar a los animales salvajes en su hábitat natural, los hace más conscientes de los impactos creados por actividades humanas. Aunque algunos buzos ya son conscientes de sus decisiones y cómo afectan al medio ambiente, la actividad de submarinismo es insuficiente para no cambiar su comportamiento.

Los buzos fueron perfilados en cuanto a su comportamiento en el "consumo de plástico y desecho de provisiones", dicho comportamiento estándar puede ser dirigido a buzos ya certificados. Esta referencia fue utilizada para comparar las dos sub-populaciones de buceadores y, por lo tanto, detectar posibles diferencias entre los dos grupos de estudio. Los buzos certificados siempre han registrado una mayor escala de comportamiento en comparación a los estudiantes de buceo, lo suficiente como para afirmar que hay una clara diferencia de comportamiento. Cuanta más alta es la puntuación en la escala

positiva de comportamiento, más probable será la utilización como “predictor” de la reducción del plástico y desechos de provisiones. Así, buzos certificados poseen una mayor tendencia a afiliarse a organizaciones medioambientales, aunque no es concluyente para sostener las diferencias entre buzos certificados y no buceadores. Más aún, la investigación de hechos no afecta a los resultados ni a las predicciones de comportamiento ambiental positivo. Ambos grupos de estudio han revelado ser conscientes de los problemas actuales del medio ambiente, lo que demuestra la preocupación y el interés en hablar con los amigos sobre los problemas relacionados con el medio ambiente.

En respuesta al segundo objetivo propuesto, el estudio ofrece indicios de que los buzos tienen prácticas aceptables, o bien hacen una buena gestión de los residuos en su hogar, como la compra de productos con el mínimo paquete posible, la compra de frutas y verduras sin paquete, buscan formas de reutilizar las cosas, participan activamente en programas de reciclaje y compran productos de temporada. Ambos grupos han mostrado tener una actitud positiva para reducir los descartes de plástico y provisiones, percibiendo qué comportamiento se puede realizar, cuándo y cómo se puede lograr.

El buceo es una actividad ambientada en la naturaleza que permite encuentros cercanos con la fauna silvestre del medio acuático. Esta actividad sigue en demanda y desde 1992 se han expedido más de medio millón de certificaciones al año (PADI, 2013a). Cozumel es una clara respuesta al tercer objetivo de este estudio, el buceo representa más del 45 % de la motivación del turismo para visitar la isla y da soporte a la necesidad del curso de educación ambiental existente como parte del indicador propuesto por Frausto y Chale (2003). Dar oportunidad para practicar la actividad de buceo, es dar oportunidad a una gran cantidad de negocios para su desarrollo, creando empleo y aumento del producto interno bruto (PIB). Los recursos naturales tienen una razón más para estar bien administrados, garantizando la conservación de especies y la concesión de beneficios para la isla. Adicionalmente, la preservación del arrecife está directamente relacionada con la gestión de zonas costeras y de su desarrollo, con una eficacia debido a los buzos que visitan el arrecife y que pueden detectar a diario los impactos que afectan al ecosistema.

A partir de los datos recogidos, se entiende que más de dos tercios de los buzos certificados no reconocen su comportamiento como influencia de la actividad de buceo. No obstante, es determinante para que la gente se

conciencie de los desechos marinos y demás cuestiones relacionadas con los problemas ambientales. La sinergia entre el buceo y el comportamiento en el hogar, ha sido también estudiada a través del efecto a largo plazo causado al 30 % del total de los participantes, en particular a los alumnos de buceo (42.86 % de los encuestados). El porcentaje es comparable con estudios anteriores, que han utilizado consideraciones sobre el impacto a largo plazo (Kittleson, 1997; Bech y Kristensen, 2009; Falk et al., 2009; Sánchez-Fernández et al., 2012) y son suficientes para proporcionar argumentos y aceptar la hipótesis.

"H_0: El turismo de naturaleza, tipo la práctica de buceo, incide positivamente en el comportamiento personal con el medio ambiente, con respecto a desechos de plástico y de alimentos en el hogar."

En primer lugar hay que señalar que la estadística es puramente cualitativa, ofreciendo valores indicativos para afirmar que la conciencia, la actitud hacia el comportamiento y el control de comportamiento percibido utilizados en el modelo tienen un alto valor predictivo. Junto con la experiencia de buceo y las variables socio- demográficas, todas las variables están favoreciendo para que las personas cambien su comportamiento en el hogar. El estudio a largo plazo compara observaciones de los buzos cuando se han involucrado en la actividad de Cozumel, y de 4 a 6 meses más tarde. Las variables examinadas para la conciencia ambiental y las actitudes hacia el comportamiento son decisivas para sostener la hipótesis, donde el buceo es una actividad de turismo de naturaleza que se puede utilizar como medio para aumentar la conciencia ambiental y educar a la gente acerca de los ecosistemas marinos.

Al comparar el comportamiento anterior y posterior a la experiencia, las diferencias no son prominentes, pero al investigar producto por producto, los hechos se destacan por un cierto nivel de cambio de comportamiento. Así, que hay que suponer que durante las vacaciones, los participantes pueden haber contestado al azar, sin prestar mucha atención, pero en el estudio a largo plazo, estarían más comprometidos a proporcionar una retroalimentación y, en aquel momento señalando, un comportamiento más justo.

Productos de plástico o relacionados con este material, tienen una alta tasa de descartes en el hogar, evidenciando la dependencia de la población

sobre su uso, como por ejemplo los envases de alimentos y las botellas de plástico. Del mismo modo, el desecho de alimentos en mal estado, la fruta y el exceso de alimentos preparados es una práctica común entre los estudiantes de buceo, mostrando realidades de una rutina que justifica una mayor atención y una solución diferente.

De la misma manera que un tercio de los buzos certificados estadounidenses reconocen que el buceo ha influido en el comportamiento ambiental de su rutina diaria, también cuenta como argumento sólido para la aceptación de la hipótesis, satisfaciendo así las declaraciones presentadas por los alumnos de buceo de esta investigación. Los buzos han reportado mejoras en su conciencia ambiental y, como resultado, los nuevos buceadores fueron motivados a hacer algunos cambios en el hogar. También se han dado cuenta de lo importante que es proteger el ecosistema, empezando a cuestionarse, por ejemplo, cómo ser un turista más respetuoso con el medio ambiente, o como buscar la manera de reciclar. Cambios visibles en el comportamiento pueden darse cuando los buceadores dan más importancia a la utilización de una lista de la compra, minimizando el gasto en productos innecesarios para la casa, lo que contribuye a una mejor organización de la despensa. La eficiencia en la separación de basura y la participación activa en el plan de reciclaje, han sido registradas como cambios sustanciales en el hogar.

El buceo no es un “predictor” de buen comportamiento ambiental, pero ha mostrado ser una actividad de turismo de naturaleza importante para fomentar la educación ambiental y la sensibilización por el medio ambiente. El buceo es un facilitador directamente relacionado con los buenos “predictores” de las prácticas de gestión de residuos en el hogar. La teoría del comportamiento planificado (Ajzen, 1991) sirve de base para el modelo propuesto, donde las actitudes en el comportamiento y en la conciencia ambiental son importantes “predictores” de prácticas ambientales. Las variables que describen aspectos socio-demográficos de los participantes, han puesto de manifiesto que no tienen tanto poder como “predictores”, con la excepción de la ubicación geográfica en el país en el que los buzos están viviendo y en la renta familiar anual.

Grossling y Garrod (2008) se refieren a la falta de investigación en el campo del buceo, aunque por el momento hay suficiente literatura disponible para una introducción de la actividad. Hay registros sobre algunos impactos de

los animales salvajes y sobre la sociedad local, cuánto puede afectar la actividad de buceo al arrecife, el valor económico de ciertas especies, las tarifas de parque marinos o una pequeña dispersión de buceadores en el mundo. Sin embargo, la literatura debe ser actualizada ya que muchos estudios son anteriores al año 2010 y no hay ningún registro real de cuántas personas practican buceo actualmente. Los datos pueden estar disponibles en línea o por petición a las agencias de entrenamiento, pero sólo reflejan el número de certificaciones y estas no son suficientes como referencia de la cantidad de buzos que siguen en activo.

Appendix A - Survey for certified divers

University of Quintana Roo, Cozumel.

This enquiry is designed to study the effect of scuba diving activity, on Cozumel Island, and environmental behaviours, back in the visitor's household. We would like to thank to all visitors, with a minimum of 18 years old, for participating in the study. Environmental perception and behavioural change will be accessed throughout 2 questionnaires while you are in the diving ground and the last one by email after 2 months back in your house.

1. The following section is to describe potential knowledge about environment in general.

1.1. I am a member of an environmental organization. □ No. □ Yes.

Which one? _____

1.2. I talk with friends about problems related to the environment. □ No. □ Yes.

What? _____

2. <u>If you are taking a diving course, please answer the following 2 questions. Certified divers go to point # 3:</u>

2.1. Did you ever try scuba diving before? □ No. □ Yes,

How many times? _____

2.2. What diving courses are you taking? _____

3. <u>If you are a certified diver, please answer the following questions:</u>

3.1. What is you certification level? _____

3.2. In total, how many dives do you have? _____

3.3. Since you have started diving, did you change your behaviour towards the environment, in your house?

□ No, I did not change anything.

□ Yes, I did change: _____

4. Using the 5-point scale you can describe personal attitudes in your household. Please circle the number, which applies best to you.

Scale (**0** – I don't know; **1** – I never do it; **2** – I do it sometimes; **3**- I do it often; **4** – I do it always).

4.1. I buy things that are produced with as little packaging as possible.	0 1 2 3 4
4.2. I use my own bag when going shopping, rather than one provided by the shop.	0 1 2 3 4
4.3. I buy fruit and vegetables without package.	0 1 2 3 4
4.4. I compost my kitchen waste. .	0 1 2 3 4
4.5. When shopping, I assess the type of packaging and choose one that is recyclable.	0 1 2 3 4
4.6. I purchase organic food.	0 1 2 3 4
4.7. I purchase biodegradable products.	0 1 2 3 4
4.8. I look for ways to reuse things.	0 1 2 3 4
4.9. I recycle recyclable materials like newspapers, cans, or bottles.	0 1 2 3 4
4.10. For shopping, I prefer paper bags to plastic ones.	0 1 2 3 4
4.11. I buy seasonal produce.	0 1 2 3 4

5. Regarding your social relationships and environmental behaviour, you can say that:

5.1. Most people I know contribute to help the environment.

□ True. □ False.

5.2. Looking for recyclable products has become part of my routine.

□ True. □ False.

6. <u>Please write down your details. They will be confidential and exclusively used for this Ph.D. thesis.</u>

6.1. **In which part of the country do you live?** □Inland area. □ Coastal area.

6.2. **How would you describe where you live?**

□ Rural area. □ Urban area. □ City. □ Highly populated city.

6.3. **What is the motivation of your trip?**

□ Leisure. □ Diving. □ Nature. □ Beach holiday.

□ Culture. □ Business. □ Other, _____

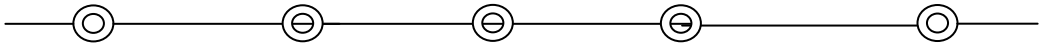
6.4. **Please write your age: _____**

6.5. **Gender:** □ Male. □ Female.

6.6. **Please indicate your education level:**

□ High School. □ Bachelors. □ Master.□ Ph.D. □ Other, _____

6.7. **What is your annual household income, in <u>USD</u>:**



≤15000 15001 to 25000 25001 to 35000 35001 to 45000 more then 45000

7. The last phase of the study will be done online. Would you like to participate? □ No.

□ Yes, in which way is best for you?

□ Email. □ Facebook. □ LinkedIn. □ Google+. □ Orkut.

□Other: _____

7.1 Name: _____ Surname: _____

7.2 Email**:** _____

7.3 Home address: _____

The End. <u>Thank you very much for your participation.</u>

<u>For diving students, after you finish your course please ask for questionnaire # 2.</u>

Legal data protection

Only people with a minimum of 18 years old of age can participate in this study. On behalf of the Federal Law for Personal Data Protection in Mexico (LFPDPP) from 5th of July of 2010, and the Federal Privacy Act in the United States of America from 1974, you are informed that data collected in this survey is strictly confidential and only for academic purposes .

Appendix B - Survey for student divers.

University of Quintana Roo, Cozumel.

This survey was developed in reference to the "Project AWARE – Dive against debris" and "PADI AWARE Coral Reef Conservation." The study is focused in studying effects of diving courses in Cozumel and potential behavioural changes in the household of a tourist. We would like to thank you for your participation in this 2nd questionnaire.

Taking in account your personal observations, during your diving course, hydrodynamic of the reef and general environmental awareness, please kindly mark with a cross (X) the answer, which suits you better.

1. In total, how long are you staying on Cozumel Island?

1 day. 2 to 4 days. 5 to 7 days. + 7 days.

2. Did you enjoy your diving course on Cozumel Island?

□ Yes.

□ No / No answer. What reason? _____

3. During your excursion to the dive sites, did you notice any marine debris?

□ No.

□ Yes. What type? _____

4. Please signal how much of these material you have consumed while staying on Cozumel island:

4.1	Plastic bags.	0	1	2	3	4	5	+
4.2	Plastic cups.	0	1	2	3	4	5	+
4.3	Styrofoam cups.	0	1	2	3	4	5	+
4.4	Packages of cigarettes.	0	1	2	3	4	5	+
4.5	Food containers.	0	1	2	3	4	5	+
4.6	Plastic bottles.	0	1	2	3	4	5	+
4.7	Drinking straws.	0	1	2	3	4	5	+
4.8	Beer bottles.	0	1	2	3	4	5	+
4.9	Batteries –AA, AAA, C & D, 6V, 9V, etc.	0	1	2	3	4	5	+
4.10	Other:_____	0	1	2	3	4	5	+

5. During your visit to Cozumel, did you ever talk to people about environmental problems?

□ Yes. □ No.

6. What benefits do communities have from living near coral reef area?

□ Coral reef areas generate economic benefits for the local communities.

□ Coral reef only benefits marine species.

□ Coral reef areas provide lots of art crafts souvenirs, made from real coral, to sell to tourists.

□ Doesn't know, not answering.

□ Other, _____

7. In order to reduce marine debris, what would you suggest to change in your household?

□ Reduce materials. □ Purchase with less packing.

□ Purchase of recyclable goods. □ I will continue the same practices as always in my house.

□ Using shopping list. □ Separate waste in my household.

□ Other: _____

8. <u>Please write down your details. They will be confidential and exclusively used for this Ph.D. thesis.</u>

8.1 **In which part of the country do you live?** □Inland area. □ Coastal area.

8.2 **How would you describe where you live?**

□ Rural area. □ Urban area. □ City. □ Highly populated city.

8.3 **What is the motivation of your trip?**

□ Leisure. □ Diving. □ Nature. □ Beach holiday. □ Culture.□ Business. □ Other, _____

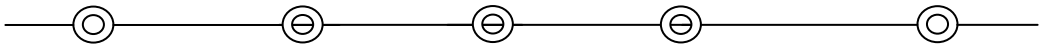
8.4 **Please write your age: _____**

8.5 **Gender:** □ Male. □ Female.

8.6 **Please indicate your education level:**

□ High School. □ Bachelors. □ Master. □ Ph.D. □ Other, _____

8.7 **What is your annual household income, in <u>USD</u>:**



≤15000 15001 to 25000 25001 to 35000 35001 to 45000 more then 45000

9 The last phase of the study will be done online. Would you like to participate? □ No.

□ Yes, in which way is best for you?

□ Email. □ Facebook. □ LinkedIn. □ Google+. □ Orkut.

□ Other: _____

9.1 Name: _____ Surname: _____

9.2 Email**:** _____

9.3 Home address: _____

The End. <u>Thank you very much for your participation.</u>

<u>For diving students, after finish questionnaire # 2 your will receive an email within 2 months for participating on the final phase of the study.</u>

Legal data protection

Only people with a minimum of 18 years old of age can participate in this study. On behalf of the Federal Law for Personal Data Protection in Mexico (LFPDPP) from 5th of July of 2010, and the Federal Privacy Act in the United States of America from 1974, you are informed that data collected in this survey is strictly confidential and only for academic purposes .

Appendix C - Survey for long-term impact on divers' behaviour in the household.

University of Santiago de Compostela and Universidad de Quintana Roo.

During your stay on Cozumel Island, you have participated on a diving tourism study happening in your dive center. If you remember, you have volunteered for online participation, the last phase of the study and we would like to thank you for your time and support.

This survey is crucial for understanding possible behavioural changes produced by a diving course or diving activity, in regarding the use of plastic and food waste in the household.

Please insert your code number: _____

Your name is: _____

1. **Since you have returned from your diving on Cozumel, did you share your experience with anyone, what?**

_____
_____

2. **Since you have taken your very first dive ever, in what way did you change your behaviour towards the environment, in your household?**

_____
_____

3. **What type of materials do you recycle in your house?**

_____
_____

4. **Using the 5 point scale you can describe personal attitudes in your household. Please circle the number which applies best to you.**
   Scale (**0** – I don't know; **1** – I never do it; **2** – I do it sometimes; **3**- I do it often; **4** – I do it always).

4.1. I buy things that are produced with as little packaging as possible.	0 1 2 3 4
4.2. I use my own bag when going shopping, rather than one provided by the shop.	0 1 2 3 4
4.3. I buy fruit and vegetables without package.	0 1 2 3 4
4.4. I compost my kitchen waste. .	0 1 2 3 4
4.5. When shopping, I assess the type of packaging and choose one that is recyclable.	0 1 2 3 4
4.6. I purchase organic food.	0 1 2 3 4
4.7. I purchase biodegradable products.	0 1 2 3 4
4.8. I look for ways to reuse things.	0 1 2 3 4
4.9. I recycle recyclable materials like newspapers, cans, or bottles.	0 1 2 3 4
4.10. For shopping, I prefer paper bags to plastic ones.	0 1 2 3 4
4.11. I buy seasonal produce.	0 1 2 3 4

5. Please circle the amount of materials disposed daily in your house:

5.1. Plastic bags.	0	1	2	3	4	5	+
5.2. Yogurt plastic cups.	0	1	2	3	4	5	+
5.3. Food containers.	0	1	2	3	4	5	+
5.4. Plastic bottles.	0	1	2	3	4	5	+
5.5. Drinking straws.	0	1	2	3	4	5	+
5.6. Beer bottles.	0	1	2	3	4	5	+
5.7. Rotten food.	0	1	2	3	4	5	+
5.8. Fruits	0	1	2	3	4	5	+
5.9. Over prepared food.	0	1	2	3	4	5	+

6. What type of goods do you look for recycling in your daily routine?

_____

_____

7. Since you have returned from Cozumel Island, did you change any behaviour in your household?

(Signal as many as you need)

□ Reduce materials.

□ Purchase with less packing.

□ Purchase of recyclable goods.

□ I will continue the same practices as always in my house.

□ Using shopping list.

□ Separate waste in my household.

□ Other: _____

8. In what country are you living? _____

9. Please write the name of the city where you live: _____

10. For any comments please write bellow:

_____

_____

The End. Thank you very much for your participation, your response has been recorded.

Legal data protection

Only people with a minimum of 18 years old of age can participate in this study. On behalf of the Federal Law for Personal Data Protection in Mexico (LFPDPP) from 5th of July of 2010, and the Federal Privacy Act in the United States of America from 1974, you are informed that data collected in this survey is strictly confidential and only for academic purposes .

Appendix D - Using Cronbach's alpha for testing reliability on Likert-type scales.

Case Processing Summary

		N	%
Cases	Valid	180	100.0
	Excluded[a]	0	.0
	Total	180	100.0

a. List wise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.783	.790	11

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
26.39	39.346	6.273	11

Item Statistics

	Mean	Std. Deviation	N
4.1 - I buy things that are produced with as little packing as possible.	2.27	.974	180
4.2 - I use my own bag when going shopping, rather than one provided by the shop.	2.02	1.189	180
4.3 - I buy fruit and vegetables without package.	2.98	.890	180
4.4 - I compost my kitchen waste.	1.53	1.106	180
4.5 - When shopping, I assess the type of packing and choose one that is recyclable.	1.88	.892	180
4.6 - I purchase organic food.	2.21	.974	180
4.7 - I purchase bio-degradable products.	2.36	.856	180
4.8 - I look for ways to reuse things.	2.80	.918	180
4.9 - I recycle recyclable materials like newspapers, cans or bottles.	3.08	1.126	180
4.10 -For shopping, I prefer paper bags to plastic ones.	2.32	1.276	180
4.11 - I buy seasonal produce.	2.94	.870	180

Inter-Item Correlation Matrix	4.1 - I buy things that are produced with as little packing as possible.	4.2 - I use my own bag when going shopping, rather than one provided by the shop.	4.3 - I buy fruit and vegetables without package.	4.4 - I compost my kitchen waste.	4.5 - When shopping, I assess the type of packing and choose one that is recyclable.	4.6 - I purchase organic food.	4.7 - I purchase bio-degradable products.	4.8 - I look for ways to reuse things.	4.9 - I recycle recyclable materials like newspapers, cans or bottles.	4.10 -For shopping, I prefer paper bags to plastic ones.	4.11 - I buy seasonal produce.
4.1 - I buy things that are produced with as little packing as possible.	1.000	.416	.181	.155	461	.139	.332	.318	.327	.293	.262
4.2 - I use my own bag when going shopping, rather than one provided by the shop.	.416	1.000	.233	.261	.344	.339	.334	.331	.366	.291	.293
4.3 - I buy fruit and vegetables without package.	.181	.233	1.000	.103	.215	.314	.282	.282	.169	.060	.330
4.4 - I compost my kitchen waste.	.155	.261	.103	1.000	.239	-.017	.076	.172	.186	.016	.106
4.5 - When shopping, I assess the type of packing and choose one that is recyclable.	.461	.344	.215	.239	1.000	.240	.354	.387	.365	.254	.236
4.6 - I purchase organic food.	.139	.339	.314	-.017	.240	1.000	.351	.129	.163	.322	.238
4.7 - I purchase bio-degradable products.	.332	.334	.282	.076	.354	.351	1.000	.390	.226	.155	.282
4.8 - I look for ways to reuse things.	.318	.331	.282	.172	.387	.129	.390	1.000	.399	.103	.322
4.9 - I recycle recyclable materials like newspapers, cans or bottles.	.327	.366	.169	.186	.365	.163	.226	.399	1.000	.274	.312
4.10 -For shopping, I prefer paper bags to plastic ones.	.293	.291	.060	.016	.254	.322	.155	.103	.274	1.000	.313
4.11 - I buy seasonal produce.	.262	.293	.330	.106	.236	.238	.282	.322	.312	.313	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
4.1 - I buy things that are produced with as little packing as possible.	24.12	32.711	.511	.338	.758
4.2 - I use my own bag when going shopping, rather than one provided by the shop.	24.38	30.404	.574	.355	.748
.3 - I buy fruit and vegetables without package.	23.42	34.781	.359	.222	.774
4.4 - I compost my kitchen waste.	24.86	35.260	.218	.124	.792
4.5 - When shopping, I assess the type of packing and choose one that is recyclable.	24.51	32.933	.548	.351	.755
4.6 - I purchase organic food.	24.18	34.039	.383	.299	.772
4.7 - I purchase bio-degradable products.	24.04	33.870	.476	.306	.763
4.8 - I look for ways to reuse things.	23.59	33.349	.486	.334	.761
4.9 - I recycle recyclable materials like newspapers, cans or bottles.	23.32	31.827	.492	.289	.759
4.10 -For shopping, I prefer paper bags to plastic ones.	24.07	32.481	.360	.254	.779
4.11 - I buy seasonal produce.	23.45	33.813	.472	.267	.763

Appendix E - Fieldwork moments

Appendix F - Survey variable coding.

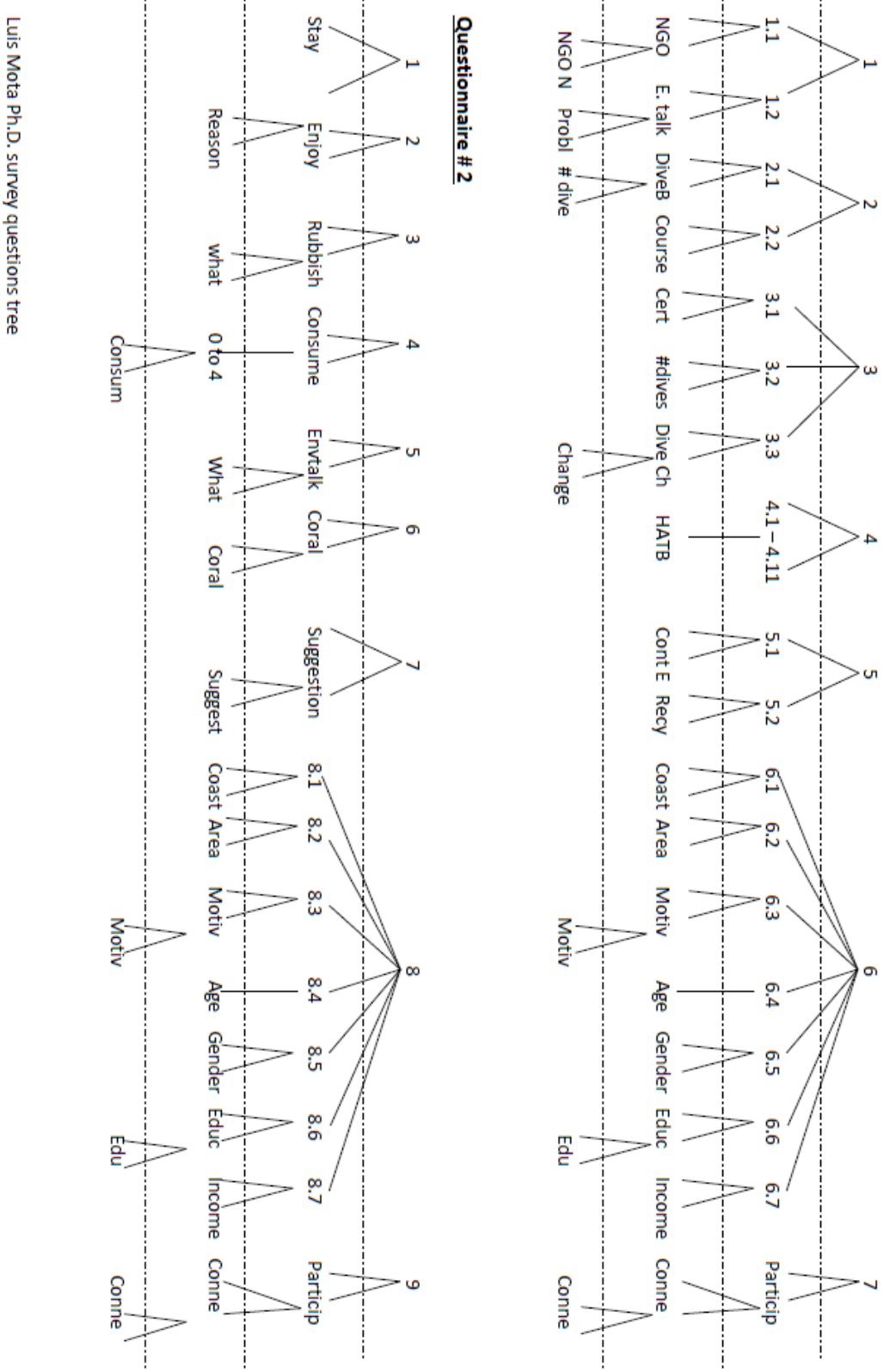
Survey # 1	**Quantitative & qualitative variables**	
Model Variable	**Attribute**	**Description**
AWAREs1	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
1.1	Name:	AWAREs1_1_1
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	AWAREs1_1_1_1
	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.
1.2	Name:	AWARE s1_1_2
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	AWAREs1_1_2_1
	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.
3.3	Name:	AWARE s1_3_3
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	AWARE s1_3_3_1
	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String - nominal.
DIVEs1	Type:	Dependent, categorical, nominal.
	SPSS scale:	Nominal.
2.1	Name:	DIVE s1_2_1_0
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	DIVE s1_2_1_1
	Type:	Dependent, categorical, ordinal.
	SPSS scale:	Ordinal.
2.2	Name:	DIVE s1_2_2
	Type:	Dependent, categorical, ordinal.
	SPSS scale:	Ordinal.
3.1	Name:	DIVE s1_3_1
	Type:	Dependent, categorical, ordinal.
	SPSS scale:	Ordinal.
3.2	Name:	DIVE s1_3_2
	Type:	Independent, numerical, discrete.
	SPSS scale:	Ordinal
HATPs1	Type:	Independent, categorical, ordinal.
	SPSS scale:	Ordinal.
4	Name:	HATP s1_4_1 – HATP s1_4_11.
	Type:	Independent, categorical, ordinal.
	SPSS scale:	Ordinal.
SUbNORMs1_5_1	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
PBCs1_5_2	Type:	Independent, categorical, nominal.

	SPSS scale:	Nominal.
DEMOs1	Type:	Dependent, categorical, nominal.
	SPSS scale:	Nominal.
6.1	Name:	DEMO s1_6_1
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
6.2	Name:	DEMO s1_6_2
	Type:	Independent, categorical, nominal
	SPSS scale:	Nominal.
6.3	Name:	DEMO s1_6_3
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	DEMO s1_6_3_1
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String - nominal.
6.4	Name:	DEMO s1_6_4
	Type:	Independent, numeric, continuum.
	SPSS scale:	Ordinal.
6.5	Name:	DEMO s1_6_5
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
6.6	Name:	DEMO s1_6_6
	Type:	Dependent, categorical, ordinal.
	SPSS scale:	Ordinal.
	Name:	DEMO s1_6_6_1
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.
6.7	Name:	DEMO s1_6_7
	Type:	Independent, numeric, continuum.
	SPSS scale:	Ordinal.
7	Name:	DEMO s1_7_0
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	DEMO s1_7_0_1
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
7.1	Name:	DEMO s1_7_1
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.
7.2	Name:	DEMO s1_7_2
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.
7.3	Name:	DEMO7_3
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.

Survey # 2	Quantitative & qualitative variables	
Model Variable	**Attribute**	**Description**
DIVEs2_1	Type:	Independent, numeric, continuum.
	Scale:	Ordinal
AWAREs2	Type:	Independent, discrete, infinite.
	SPSS scale:	Nominal.
2	Name:	AWAREs2_2_0
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	AWAREs2_2_1
	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.
3	Name:	DIVE s2_3_0
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	AWAREs2_3_1
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.
5	Name:	AWAREs2_5
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
6	Name:	AWAREs2_6
	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	AWAREs2_6_1
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.
HATPs2	Type:	Independent, discrete, finite.
	SPSS scale:	Scale.
4	Name:	HATP s2_4_1 – HATP s2_4_10.
	Type:	Independent, categorical, ordinal.
	SPSS scale:	Ordinal
	Name:	HATPs2_4_10_1
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String - nominal
PBC s2_7_0	Type:	Independent, categorical, nominal.
	SPSS scale:	Nominal.
	Name:	PCBs2_7_1
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.

Survey # 3	Quantitative & qualitative variables	
Model Variable	**Attribute**	**Description**
DEMOs3	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String.
0_1	Name:	DEMOs3_01
	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.
0_2	Name:	DEMOs3_02
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.
8 to 10	Name:	DEMOs3_8 – DEMOs3_10
	Type:	Independent, categorical, qualitative.
	SPSS scale:	String – nominal.
AWAREs3_1	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.
BEHs3	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.
2 & 3	Name:	BEHs3_2,BEHs3_3
	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.
7	Name:	BEHs3_7
	Type:	Dependent, categorical, nominal.
	SPSS scale:	Nominal.
HATPs3	Type:	Independent, categorical, ordinal.
	SPSS scale:	Ordinal
4	Name:	HATPs3_4_1 – HATPs3_4_11.
	Type:	Independent, categorical, ordinal.
	SPSS scale:	Ordinal
5	Name:	HATP s3_5_1 – HATP s3_5_9.
	Type:	Independent, categorical, ordinal.
	SPSS scale:	Ordinal
PBCs3_6	Type:	Dependent, categorical, qualitative.
	SPSS scale:	String – nominal.

Appendix G - Survey variable tree.



Luis Mota Ph.D. survey questions tree

Appendix H - Interview to diving professionals on Cozumel.

University of Quintana Roo, Cozumel.

For the closure of the Ph.D. research, fieldwork in Diving Tourism developed on Cozumel Island, there is place for a semi-structured interview for better understanding of the population in study and their behaviour towards the environment. Aiming to catch the opinion of diving professionals involved on the diving scene, questions are focused on divers' environmental conscience, the acquisition of the new knowledge, opportunity to act reducing plastic use and marine debris.

Taking in account your personal observations and experience on Cozumel, kindly answer the following questions:

1. **Location, time, and date of the interview.**
2. **Please tell your name, age, nationality, name of the company and what is your position on the company?**
3. **In total, how many years have you been working on Cozumel Island?**
4. **What can you say about Cozumel environmental problems and how are they related with the coral reef?**
    - **4.1. What about plastic?**
5. **Having diving staff and captains trained by the National Park, in what way costumers take your crew as role model?**
6. **Apart from using the Park wristband do divers know anything about the National Park or do they look for specific details?**
    - **6.1. Touching animals underwater or fish feeding?**
    - **6.2. Buoyancy control to avoid damaging the reef?**
7. **Do your costumers get involved with reef protection actions like reef, beach cleaning or fundraising for local organizations?**
8. **Do your costumers request for drinks and food items for their diving trip, anything in particular?**
9. **Do your diving costumers compare Cozumel with their home place regarding environmental practices?**
    - **9.1. Do your costumers adopt different ways to reuse plastic or avoid littering?**
    - **9.2. Have you noticed any difference since they were diving with you, or on Cozumel, the first time?**
10. **Looking for a solution, what would you suggest to educate tourists for better environmental practice regarding plastic disposal and food waste?**

The End. **Thank you for your collaboration.**

Legal data protection

Only people with a minimum of 18 years old of age can participate in this study. On behalf of the Federal Law for Personal Data Protection in Mexico (LFPDPP) from 5th of July of 2010, and the Federal Privacy Act in the United States of America from 1974, you are informed that data collected in this survey is strictly confidential and only for academic purposes .

Appendix I - Table 4.26: Clusters formed for plastic and food waste reduction.

Inputs	# clusters	Smaller	Larger	Ratio	Fitness		Clustering variables	X^2/ Fisher
1.1 + 4.5 + 5.2	4	31	38	1.23	0.9	Good	2	0.000
1.2 + 4.1 + 5.2	2	68	75	1.10	0.6	Good	2	0.000
1.2 + 4.2 + 5.2	2	69	79	1.14	0.6	Good	2	0.000
1.2 + 4.3 + 5.2	2	61	71	1.16	0.7	Good	1	0.000
1.2 + 4.4 + 5.2	2	75	82	1.09	0.6	Good	2	0.000
1.2 + 4.5 + 5.2	2	64	76	1.19	0.6	Good	2	0.000
1.2 + 4.6 + 5.2	2	73	76	1.04	0.6	Good	2	0.000
1.2 + 4.8 + 5.2	2	77	79	1.03	0.6	Good	2	0.000
1.2 + 4.10 + 5.2	2	69	73	1.06	0.6	Good	2	0.000
1.2 + 4.11 + 5.2	2	72	82	1.14	0.6	Good	2	0.000
1.2 + 3.1 + 5.2	3	**17**	34	2.00	0.7	Good	3	0.000
1.2 + 3.1 + 4.1	2	36	57	1.03	0.6	Good	1	0.000
1.2 + 3.1 + 4.2	3	**17**	26	1.53	0.5	Good	2	0.000
1.2 + 3.1 + 5.2	3	**17**	34	2.00	0.7	Good	2	0.000
1.2 + 2.2 + 5.2	4	**17**	26	1.53	0.9	Good	3	0.000
1.2 + 2.2 + 4.8	3	**28**	40	1.43	0.7	Good	1	0.000
1.2 + 4.2 + 5.1	4	**28**	54	1.93	0.5	Fair	3	0.000
1.2 + 4.2 + 6.1	2	58	86	1.48	0.4	Fair	2	0.000
1.2 + 4.2 + 6.2	3	**27**	71	2.63	0.5	Fair	2	0.000
1.2 + 4.2 + 6.6	3	**28**	57	2.04	0.3	Fair	3	0.000
1.2 + 4.2 + 6.7	2	51	65	1.27	0.4	Fair	1	0.000

Source: Mota, 2013.

Appendix J - Long-term behavioural change list of records.

2 - Since you have taken your very first dive ever, in what way did you change your behaviour towards the environment, in your household?

(Web survey in Mota, 2013)

- We have always been environmentally conscious. Recycling is something that is encouraged by municipal government and reusable shopping bags have been encouraged by stores charging for plastic. We tend to pick up garbage when we are walking our dogs to make our neighbourhood cleaner.
- My behaviour hasn't changed much, since I have always been trying to look after my trash, never threw away something not to a bin.
- I use to recycle house hold items, etc anyway, so have continued to do so.
- I have always been environmentally conscious, so diving has not changed that much.
- No, I already recycle.
- None, I already feel I am aware of my decisions and how they affect the environment
- Not much change.
- I don't believe I have changed my behaviour - I have been environmentally conscientious from a young age.
- Not too much. I have always tried to be environmentally aware of how I dispose of waste.
- I have not changed my behaviour towards the environment.
- I haven't changed anything.
- I am more conscious about how garbage impacts aquatic life, and ruins dive sites.
- Am much more environmentally conscious
- be more environmentally friendly
- I am more conscious of what I throw away, particularly hazardous materials. I also donate more items to thrift stores so they will be reused instead of sitting in a landfill. I use a water filter pitch.
- Am much more environmentally conscious
- I am much more aware of the rubbish and waste that is thrown into out oceans.
- I have spent time on several different islands during the last few years, and I am much more aware about the difficulty of removing trash from islands. I am more conscious about recycling all materials, but especially plastics.
- I think I have always been environmentally aware, this being able to scuba and see the beauty underwater just reinforced the need to be respectful of all nature in all environments.

- eating only certified (Marine Conservation Society - MSC) sustainable seafood; saving water; stopped all consumption of Tuna; using bio degradable cleaning materials and soaps
- I am more conservative with water use, have changed my diet to not eat endangered fish, and educate others on the importance of ocean care.
- I am much more aware of the rubbish and waste that is thrown into out oceans.
- I am very interested the ecology of our oceans and lakes. We MUST cut down on the pollution and over harvesting of the resources.
- Diving has changed my life and I have stopped eating shark.
- I have been eating less beef products, because in Australia, run off from grazing crops affects the Great Barrier Reef. I have also stopped eating tuna.
- I don't know if it can be attributed to diet, but we are more conscientious about the kind of foods we eat with respect to sustainable seafood.
- We are much more careful in conservation of fresh water, electricity and fossil fuels
- More recycling, trying to use less.
- I am more conscious of what I throw away, particularly hazardous materials. I also donate more items to thrift stores so they will be reused instead of sitting in a landfill. I use a water filter pitcher instead of buying bottled water. I leave the air conditioning off during the day and turn off lights when not in use.
- More conscious of the world UNDER the surface of the water.
- I am more conscious about how garbage impacts aquatic life, and ruins dive sites.
- Recycle more.
- I don't think much has changed, as we're pretty Eco already I believe but I am more aware of endangered fish/ reef damages.
- We cut up the plastic around our bottles so nothing can get caught in it. We recycle what we can.
- more recycling, healthier eating habits (went vegan),
- I Really Haven't, That's Something I Would Like To Address In My Household
- It was after our trip to Belize when we became more aware of just how much plastic ends up in the ocean. That was depressing. We make an extra effort now to recycle plastic when we can.
- stopped eating fish
- Since I have recycled at my house for a long time, the biggest change I made after this trip, was trying to turn the water off when not in use, taking shorter showers etc.
- I try to not use plastic straws. I try to avoid using plastic bottles or at least reuse them. I've started a compost pile in the backyard for food scraps and coffee grounds. I try to net get plastic bags if I don't need them, especially when I'm in Asia and they try to give you a bag even when you buy a small pack of gum or a coke

- you definitely try to recycle more, as I work on cruise ships recycling and trying to keep the environment clean is always been instilled as a number one priority
- If anything it just reinforced my belief that the environment is precious and should be treated as a gift from nature. Naturally so we can continue to enjoy it and pass on the possibilities to our future.
- Viendo la consta de Cozumel que estaba devastada y sin arrecife coral natural. Solo vimos como se quería recuperar el borde con esas estructuras de hormigón para que los peces volvieran a habitar el sector
- Plastics recycling, trash separation, and purchase of biodegradable products.
- i started to recycle more.
- I must clarify that this was not my first dive ever. Also, I have not really changed anything in my household in regards to my behaviour and the environment.
- Learned how valuable our underwater habitat is, especially reefs which has made me more aware of our outdoor environment here at home and around the world.
- We purchased an electric vehicle and improved on our behaviour to recycle
- We make an effort to use as few plastic bags as possible. I often tell store clerks to keep the bag so I can save a turtle.
- We do a lot of recycling anyway.
- I don't believe I have changed my behaviour - I have been environmentally conscientious from a young age.
- We do sort garbage, recycle things but I don’t find that related to diving.
- I haven't changed my behaviour. I have always been concerned about the environment, and re-cycle paper, glass, cans and plastic. I also try to minimize my use of plastic bags, and compost vegetable and fruit scraps. I also drive a Toyota Prius to get good gas mileage.
- That the sea life is delicate. I kept encouraging my friends to take up diving to see the ocean life for themselves. I am now more aware of and attuned to going-to-be extinct sea life and my fiancé & I talk to other about it.
- This was not my first dive. But I have increased my awareness of rain runoff. I also learned of more marine wildlife which is endangered.
- I look more online for stories about the sea environment/creatures; I talk about this more and more. I am growing more aware of the trade in fish, when I shop. Where I live, we are encouraged to recycle by the local council - I do this - but I am more aware of buying products that avoid even this! Recycling has become an excuse to care less about excess packaging, it seems to me.
- No change at this point. My opinion is that as I dive more frequently I will begin to pay closer attention to the pristine beauty of the underwater environment, which will encourage me to make positive behavioural changes (e.g. Recycling).

- I try to reuse/recycle more
- More conscious of impacts I make to the environment. Try to recycle, use less water and energy.
- be more environmentally friendly
- I try to recycle as much as possible and definitely buy sunscreens and products environmentally friendly!
- I have changed a lot! I recycle more and take care of the environment!
- In the 70's bouncy control was a crude adjustment and we brought up everything we could grab
- Recycling mainly and picking up trash as I see it in public places.
- I am more conservative with water use, have changed my diet to not eat endangered fish, and educate others on the importance of ocean care.
- Took additional SCUBA courses to master buoyancy. Began recycling at home. Began using biodegradable soap products.
- We always recycle plastics now. We recycle other materials, too, but I am particularly sensitive about plastics.

Appendix K - Certificate of recognition for outstanding collaborative support.

University of Quintana Roo, Cozumel

Ph.D. Fellowship – Luís Mota

Certificate of Recognition

Presented to

_____

For outstanding collaborative support as a preferred host and valuable partner of the Ph.D. program in Diving Tourism.

2013

Logo of the Diving School

_____

Luís Mota, Ph.D. Fellow University of Santiago Compostela, Spain.

_____

Professor, Ph.D. Oscar Frausto, Sustainable Development Division at Universidad de Quintana Roo, Cozumel.

Appendix L - PNAC Environmental Education Course Diploma.

La Dirección del Parque Nacional Arrecifes de Cozumel
extiende la presente

Constancia

Soares Mota Luis – Instructor de Buceo

No. de credencial: IN64130212

Por concluir el Curso- Taller:
"Manejo Sustentable del Arrecife de Coral y Buenas Prácticas"
los dias 11 y 12 de MARZO de 2013.

El presente documento NO ampara la autorización de uso de embarcaciones, que no cuenten con permiso respectivo.

Biol. Ricardo Gomez Lozano
Director
Parque Nacional Arrecifes de Cozumel

Appendix M - Table 4.31: Comparing observations from survey 1 and web survey.

Statistics		#	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11
Certified divers (n = 40)	Survey 1	Mean	2.65	2.40	3.13	1.80	2.23	2.23	2.55	3.00	3.20	2.33	2.85
		Median	3.00	2.50	3.00	1.00	2.00	2.00	3.00	3.00	4.00	3.00	3.00
		Mode	3	3	3	1	2	2	3	3	4	3	3
		SD	1.027	1.081	.822	1.324	.920	.862	.815	.751	1.181	1.289	.802
	Web-survey	Mean	2.68	2.33	2.88	1.88	1.93	2.15	2.28	2.73	3.25	2.43	3.00
		Median	3.00	3.00	3.00	1.50	2.00	2.00	2.00	3.00	4.00	2.50	3.00
		Mode	3	3	3	1	2	2	2	3	4	4	3
		SD	.829	1.141	.822	1.285	1.023	.736	.751	.816	1.006	1.430	.784
Diving students (n = 30)	Survey 1	Mean	2.33	2.27	3.03	1.67	2.03	2.07	2.30	2.80	3.33	2.60	2.83
		Median	2.50	2.00	3.00	1.00	2.00	2.00	2.00	3.00	4.00	3.00	3.00
		Mode	3	2[a]	3	1	2	2	2	3	4	4	3
		SD	.884	1.081	.718	1.269	.928	.868	.837	.714	.994	1.248	.834
	Web-survey	Mean	2.33	2.07	3.17	1.73	2.00	2.07	2.23	2.80	3.47	2.23	2.90
		Median	3.00	2.00	3.00	1.00	2.00	2.00	2.00	3.00	4.00	2.00	3.00
		Mode	3	1[a]	3	1	1[a]	2	2	3	4	2	2[a]
		SD	1.093	1.172	.531	1.363	.983	.828	.817	.805	.819	1.223	.995

Note: a. Multiple modes exist; Scale: 0 – I don't know; 1 – I never do it; 2 – I do it sometimes; 3 – I do it often; 4 – I do it always (Mota, 2013).

Curriculum Vitae

LUÍS CÂNDIDO SOARES MOTA

PERSONAL DATA

Nationality	Portuguese.
Date of Birth	16 / 10 / 1974
Address	Haydnstr. 4, 91126 Schwabach, Germany.
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Languages	Portuguese, English, Spanish, Italian, German B2.
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QUALIFICATIONS

MA in Sustainable Tourism Destination Management.

5 years degree in Environmental Engineering (Pre-Bologna).

Vessel Sanitation Public Health Course – Miami, Florida – USA.

Diving Instructor for recreational diving PADI, and for disabled divers.

Primary and Secondary Care Instructor with AED for adults and children.

EDUCATION

Currently	Ph.D. thesis writing in Responsible Tourism.
01/13 – 04/13	Ph.D. fieldwork in the University of Quintana Roo - Cozumel Island.
11/12	Ph.D. Student at University of Santiago Compostela – Spain.
11/10 – 06/11	MA in Sustainable Tourism Destination Management, Gran Canary, Spain.
06/10	Instructor course for Disabled Divers International – DDI # 10 – 0087.
03/10 – 05/10	Course for European Pedagogic Aptitude – CAP # EDF 541447/2010 DN (112h).
01/09	Instructor Course for International Association for Handicapped Divers – IAHD # 30209.
08/07	Instructor Course for Professional Association of Diving Instructors – PADI # 491976, and Emergency First Response and Care for Children Instructor with AED – EFR /CFC.
01/05	Managing Retail Food Safety, Hazard plan for Cruise Industry - Food and Drug Administration (FDA), Miami, Florida - USA.
10/04	Crowd, Crisis, and Human Behaviour Management – STCW 95.
08/04	Vessel Sanitation Public Health Course – Miami, Florida – USA.
06/04	Speciation Analysis as a Modern Tool for Environmental Risk Assessment - University of Warsaw, Faculty of Analytical Chemistry.

10/94 – 09/03	University of Aveiro, Portugal – 5 year's degree in Environmental Engineering.
09/01 – 09/02	University of Granada, Spain – Erasmus Scholarship for academic achievement, subject study in environmental engineering and renewable energies. Project research in Photovoltaic Systems.
09/00 – 09/01	University of Genoa, Italy – Erasmus Scholarship for academic achievement, subject study in environmental engineering. Project research on Hydraulic Turbines.
1994	Laboratory Technician certificated - High School Diploma in Chemistry.

WORK EXPERIENCE

02/12 – 07/12	Water Sports and Excursion Manager - Base Leader, Riu Hotelin Cape on Island of Sal.
07/11 – 11/11	Dive instructor in Zanzibar and coral restoration project manager.
02/11 – 06/11	Dive guide for Let's go Diving charter boat in Gran Canary, Spain.
04/10 – 11/10	Watersports and Excursion Project Manager, iScubaSurf, Portugal.
03/07 – 02/10	Professional diving instructor in South East Asia for diving liveaboards in Thailand, Indonesia and remote bases in Lombok, East Timor and Philippines.
09/06 – 03/07	Internship for Leonardo da Vinci European program working as Environmental Health and Safety Officer in London, UK.
12/05 – 07/06	Project research for a Ph.D. scholarship with People with Restricted Capability.
08/04 – 11/05	Carnival Cruise Lines, E.U.A – Environmental Health Officer, Fleet wide Public Health Inspector.
04/04 – 07/04	Junior scientist at Centre of Complex Environmental Monitoring and Environmental Risk Assessment (CEMERA), Department of Biology, University of Warsaw, Poland.
11/02 – 01/04	Sondar – Air Sampling Technologies, Aveiro, Portugal – Environmental Officer for air sampling, team leader.

OTHER

Computer Skills:	Mac, Windows 7/8, MS Office 2011, Photoshop, SPSS 20, Internet user
Hobbies:	Kite Surfing, diving, snowboard, hiking, cooking, and traveling.
Others:	Driving license type A and B, Skipper License.